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HUMAN RESOURCES TEST AND EVALUATION SYSTEM (HRTES) VOLUME 2: SUPPLEMENT

ARI Field Unit at Fort Hood, Texas
Systems Research Laboratory

August 1984

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The Human Resources Test and Evaluation System (HRTES) is a set of procedures designed to assist a test planner in evaluating the operator and maintainer performance in an operational test of an Army system. Specifically, HRTES provides guidance for (1) identifying the critical aspects of human performance to be included in the operational test, (2) evaluating that performance, and (3) analyzing the cause(s) of any inadequate human performance. Guidance is also provided for identifying the contributions of (Continued)

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training, personnel selection, and human factors engineering to overall human performance. This volume includes detailed descriptions of a number of the test procedures and methods outlined in Volume 1 - Test Procedures. It also presents alternate methods for performing some of the steps.

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HUMAN RESOURCES TEST AND EVALUATION SYSTEM (HRTES) VOLUME 2: SUPPLEMENT

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FOREWORD

Because of their complexity, weapons and other systems being acquired by the Army will place heavy demands on operator and maintenance personnel. To avoid costly failures, the human resources aspects of these future systems must be fully evaluated early in their development cycles, so that problems can be corrected prior to full-scale production. However, the Army does not have enough personnel with human factors expertise to staff all of the system tests conducted each year. Personnel with little or no training or experience in the human factors area must often be assigned to conduct these evaluations. The Human Resources Test and Evaluation System (HRTES) was designed to meet the need for a guidance document to aid the "typical" test officer in planning and conducting human resources evaluations of proposed Army equipment.

EDGAR M. JOHNSON
Technical Director

HUMAN RESOURCES TEST AND EVALUATION SYSTEM (HRTES)
VOLUME 2: SUPPLEMENT

EXECUTIVE SUMMARY

Requirement:

Weapons and other systems being acquired by the Army are becoming increasingly complex and costly, and place ever increasing demands on operator and maintenance personnel. Recent data suggest that these personnel are responsible for over one-half of the failures of major systems. Therefore, it is imperative that the human resources aspects of future systems be fully evaluated early in the development cycle, and that problems be corrected prior to full-scale production. However, the Army does not have adequate numbers of personnel with human factors expertise to man all of the system tests conducted each year. As a result, personnel with little or no training or experience in the human factors area must often be assigned to conduct human factors evaluations. Therefore, there is an obvious need for guidance documents to aid the "typical" test officer plan and conduct human resources evaluations of Army equipment. The Human Resources Test and Evaluation System (HRTES) was designed to meet this need.

Procedure:

In developing HRTES, it was assumed that the primary purpose of tests and evaluations was to determine whether the tested systems were able to satisfy the requirements for which they were developed. Given this assumption, procedures were developed to focus first on identifying those activities or functions a system must perform. Since the emphasis in HRTES was to be on the human components of a system, procedures were then developed to identify those human activities which must be performed for the system as a whole to perform its functions. Next, procedures were developed to determine what aspects of human performance had to be measured. Finally, procedures were developed for analyzing the cause(s) of any inadequate performance. This latter guidance was designed to aid the test officer in identifying the contributions of training, personnel selection, and human factors engineering to overall human performance.

Volume 1 of HRTES, titled TEST PROCEDURES, is the primary guidance document. It describes the steps to be taken in performing each of the major tasks. Volume 2, titled SUPPLEMENT, contains detailed descriptions of a number of the test procedures and methods. Thus, the supplement can be considered to be an appendix to the Test Procedures volume.

HRTES

Human Resources Test and Evaluation System

CONTENTS

1. INTRODUCTION

No procedures are included in this chapter
of the HRTES Supplement

2. IDENTIFYING TEST ISSUES

S 2.1 Developing Test Issues

This section provides:

(1) A "System Class Index" that describes the type of Army system for which the operational test is being prepared, and

(2) A list of test issues that applies to each system class.

The procedure for developing test issues:

(1) Refer to the System Class Index and determine the system class that applies to the Army system to be tested.

(2) Turn to the page in this section that is referenced by the system class index for the Army system to be tested.

(3) Review the issues contained in the list for the Army system to be tested.

(4) Determine which issues you feel should be tested for this system.

SYSTEM CLASS INDEX

SYSTEM CLASS 1 - AIR DEFENSE WEAPONS

Including:

Short Range Missiles, Medium Range Missiles
Air Defense Guns, High Energy Systems

HOW EFFECTIVELY CAN THE SYSTEM:

1. Destroy aircraft?
2. Confuse and disrupt aircraft?
3. Deny selected airspace/formation to attacking aircraft?
4. Destroy ground targets?
5. Acquire its targets?
6. Deliver its ammunition on the target/target area?
7. Engage several targets, simultaneously?
8. Navigate?
9. Maneuver in travel?
10. Engage in self-recovery?
11. Prevent its detection and accurate location?
12. Operator(s)/troops escape?
13. Protect its operator(s)/troops/material from small arms fire and minimize the effects of major weapon fire?
14. Be moved, between operations, to minimize the probability of detection/location?
15. Represent weather?
16. Represent the status of forces?

17. Project weather conditions?

18. Select and order targets for attack?

19. Manage weapon functions?

20. Recommend logistics procedures?

21. Select the most appropriate friendly forces to engage in an operation?

22. Establish/maintain communications between organizational nodes?

23. Prevent interception/jamming of its communications?

24. Identify and route output to the most appropriate nodes of the organization?

25. Deliver the troops/material in fully operable condition?

26. Be loaded/unloaded with troops/applicable material/fuel/ammunition?

27. Be transported?

SYSTEM CLASS 2 - ARMORED VEHICLES

Including:

Main Battle Tanks, Armored Reconnaissance Vehicles/
Light Tanks, Infantry/Cavalry Fighting Vehicle
Armored Personnel Carriers/Mounting, Anti-Tank Weapons

HOW EFFECTIVELY CAN THE SYSTEM:

1. Destroy fixed emplacements?
2. Destroy armored vehicles?
3. Destroy enemy personnel?
4. Destroy/disrupt enemy aircraft?
5. Suppress/disrupt enemy activity?
6. Serve as a platform for mounted attack?
7. Deliver its ammunition on the target/target area?
8. Acquire its targets?
9. Engage several targets,
10. Navigate?
11. Maneuver in travel?
12. Maneuver in attack/defense?
13. Engage in self-recovery?
14. Prevent its detection and accurate location?
15. Operator(s) and troop(s) escape?
16. Protect its operator(s) troops/ materiel from small arms fire and minimize the effects of major weapon fire?

17. Be moved, between operations, to minimize the probability of detection/location?

18. Gather appropriate information?

19. Engage in fire control?

20. Recover a disabled vehicle?

21. Remove/breach obstacles?

22. Bridge an obstacle?

23. Establish/maintain communications

24. Prevent interception/jamming of its communications?

25. Identify and route output to the most appropriate nodes of the organization?

26. Deliver the troops/materiel in fully operable condition?

27. Be loaded/unloaded with troops/applicable materiel/fuel/ammunition/ wounded personnel?

28. How effectively can the system be transported?

SYSTEM CLASS 3 - AVIATION SYSTEMS

Including:

Attack Helicopters, Scout Helicopters,
Transport Helicopters, Utility Helicopters,
Fixed-Wing Reconnaissance, Fixed-Wing Transport

HOW EFFECTIVELY CAN THE SYSTEM:

1. Destroy enemy vehicles?
2. Destroy anti-aircraft systems?
3. Destroy fixed emplacements?
4. Destroy enemy personnel?
5. Disrupt/suppress enemy activity?
6. Serve as platform for electronics warfare systems?
7. Transport troops/materiel?
8. Transport injured troops?
9. Acquire its targets?
10. Deliver its ammunition on the target/target area?
11. Engage several targets, simultaneously?
12. Navigate?
13. Maneuver in travel?
14. Maneuver in attack/defense?
15. Prevent its detection and accurate location?
16. Operator(s)/troop(s) escape?

17. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?

18. Be moved, between operations, to minimize the probability of detection/location?

19. Deliver the troops/materiel in fully operable condition?

20. Be loaded/unloaded with troops/applicable materiel/fuel/ammunition/wounded personnel?

21. Establish/maintain communications between organizational nodes?

22. Prevent interception/jamming of its communications?

23. Identify and route output to the most appropriate nodes of the organization?

24. Gather appropriate information?

25. Engage in fire control?

26. Be transported?

SYSTEM CLASS 4 - BATTLEFIELD COMMUNICATION SYSTEMS

Including:

Man-Portable Radios, Vehicle-Portable Radios,
Visual Communications Systems, and Base Radio Systems

HOW EFFECTIVELY CAN THE SYSTEM:

1. Transfer information and orders between concerned units/individuals?
2. Navigate?
3. Maneuver in travel?
4. Engage in self-recovery?
5. Prevent its detection and accurate location?
6. Operator(s)/troops escape?
7. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?
8. Be moved, between operations, to minimize the probability of detection/location?
9. Establish/maintain communications between organizational nodes?
10. Prevent interception/jamming of its communications?
11. Identify and route output to the most appropriate nodes of the organization?
12. Be transported?

SYSTEM CLASS 5 - C^3 AND C^3I SYSTEMS

Including:

Field Artillery Fire Control, Tank Fire Control, Air Defense Fire Control

HOW EFFECTIVELY CAN THE SYSTEM:

1. Provide information on current battlefield conditions and enemy behavior?
2. Provide projections of probable future conditions and enemy behavior?
3. Control the behavior of friendly forces?
4. Manage friendly weapon operation?
5. Manage logistics?
6. Communicate information to appropriate units?
7. Acquire its targets?
8. Prevent its detection and accurate location?
9. Operator(s)/troops escape?
10. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?
11. Be moved, between operations, to minimize the probability of detection/location?
12. Represent terrain/obstacles/installations/weather?
13. Represent the status of forces?
14. Gather appropriate information?
15. Engage in fire control?
16. Engage several targets, simultaneously?

17. Project battlefield operations?

18. Project weather conditions?

19. Select and order targets for attack?

20. Manage weapon functions?

21. Prepare personnel plans?

22. Recommend logistics procedures?

23. Select the most appropriate friendly forces to engage in an operation?

24. Control friendly forces on the battlefield.

25. Establish/maintain communications between organizational nodes?

26. Prevent interception/jamming of its communications?

27. Identify and route output to the most appropriate nodes of the organization?

28. Be transported?

SYSTEM CLASS 6 - COMBAT/TACTICAL SUPPORT EQUIPMENT

Including:

Combat Engineer Vehicles, Recovery Vehicles,
Demolition Equipment, and Bridging Equipment

HOW EFFECTIVELY CAN THE SYSTEM:

1. Destroy/remove obstacles/roadblocks/access ways?
2. Bridge obstacles?
3. Construct emplacement/shelters?
4. Transport command posts?
5. Transport damaged vehicles?
6. Destroy armored vehicles/personnel/thin skinned vehicles?
7. Acquire its targets?
8. Deliver its ammunition on the target/target area?
9. Engage several targets, simultaneously?
10. Navigate?
11. Maneuver in travel?
12. Maneuver in attack/defense?
13. Engage in self-recovery?
14. Prevent its detection and accurate location?
15. Operator(s)/troops escape?
16. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?
17. Be moved, between operations, to minimize the probability of detection/location?

18. Recover a disabled vehicle?

19. Deliver the troops/materiel in fully operable condition?

20. Be loaded/unloaded with troops/applicable materiel/fuel/ammunition/ wounded personnel?

21. Establish/maintain communications between organizational nodes?

22. Prevent interception/jamming of its communications?

23. Identify and route output to the most appropriate nodes of the organization?

24. Be transported?

SYSTEM CLASS 7 - ELECTRONIC WARFARE AND SURVEILLANCE SYSTEMS

Including:

Countermeasures Equipment and
Sighting and Surveillance Equipment

HOW EFFECTIVELY CAN THE SYSTEM:

1. Jam electronic signals?
2. Produce false targets/target signatures?
3. Provide critical information on potential targets?
4. Confuse/disrupt/disable enemy systems?
5. Acquire its targets?
6. Gather the appropriate information about the targets and interpret that information into meaningful data?
7. Predict target behavior?
8. Designate the appropriate targets?
9. Deliver the troops/materiel in fully operable condition?
10. Be loaded/unloaded with troops/applicable material/fuel/ammunition/ wounded personnel?
11. Navigate?
12. Maneuver in travel?
13. Maneuver in attack/defense?
14. Engage in self-recovery?
15. Prevent its detection and accurate location?
16. Operator(s)/troops escape?
17. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?

18. Be moved, between operations, to minimize the probability of detection/location?

19. Establish/maintain communications between organizational nodes?

20. Prevent interception/jamming of its communications?

21. Identify and route output to the most appropriate nodes of the organization?

22. Engage in fire control?

23. Be transported?

SYSTEM CLASS 8 - GROUND TRANSPORTATION EQUIPMENT

Including:

1/4 Ton Utility Trucks, 3/4 to 1½ Ton Trucks, 5 Ton Trucks, 8 to 10 Ton Trucks, Heavy Equipment Transport Trucks

HOW EFFECTIVELY CAN THE SYSTEM:

1. Transport command personnel?
2. Navigate?
3. Maneuver in travel?
4. Maneuver in defense?
5. Engage in self-recovery?
6. Prevent its detection and accurate location?
7. Operator(s)/troops escape?
8. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?
9. Be moved, between operations, to minimize the probability of detection/location?
10. Deliver the troops/materiel in fully operable condition?
11. Be loaded/unloaded with troops/appicable materiel/fuel/ammuntion/wounded personnel?
12. Establish/maintain communications between organizational nodes?
13. Prevent interception/jamming of its communications.
14. Identify and route output to the most appropriate nodes of the organization?
15. Be transported?

SYSTEM CLASS 9 - INFANTRY WEAPONS

Including:

Pistols/Revolvers, Rifles, Sub-Machine Guns, Machine Guns, Recoilless Rifles, Anti-Tank Missile Systems, Grenades/Grenade Launchers, Anti-Armor Mines, Anti-Personnel Mines, Flamethrowers, Mortars

HOW EFFECTIVELY CAN THE SYSTEM:

1. Destroy enemy vehicles?
2. Destroy low flying enemy aircraft?
3. Destroy fixed emplacements?
4. Destroy enemy troops?
5. Disrupt/suppress enemy activity?
6. Provide illumination?
7. Conceal friendly forces by making smoke?
8. Acquire its targets?
9. Deliver its ammunition on the target/target area?
10. Engage several targets, simultaneously?
11. Prevent its detection and accurate location?
12. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?
13. Be moved, between operations, to minimize the probability of detection/location?
14. Be transported?

SYSTEM CLASS 10 - ORDNANCE SYSTEMS

Including:

Light, Towed, Tube Artillery; Light, Self-Propelled, Tube Artillery; Medium, Towed, Tube Artillery; Medium Self-Propelled, Tube Artillery; Heavy, Self-Propelled Tube Artillery; Battlefield Support Guided Missile; Battlefield Support Unguided Missiles; Multiple Launch, Guided Missiles; Multiple Launch, Unguided Missiles

HOW EFFECTIVELY CAN THE SYSTEM:

1. Destroy fixed emplacements on or behind the battlefield?
2. Destroy enemy vehicles/weapons?
3. Destroy enemy personnel?
4. Suppress/deny enemy activity, and deny terrain to enemy?
5. Provide illumination?
6. Conceal friendly forces by making smoke?
7. Acquire its targets?
8. Deliver its ammunition on the target/target area?
9. Engage several targets, simultaneously?
10. Navigate?
11. Maneuver in travel?
12. Maneuver in attack/defense?
13. Engage in self-recovery?
14. Prevent its detection and accurate location?
15. Operator(s)/troops escape?
16. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?

17. Be moved, between operations, to minimize the probability of detection/location?

18. Deliver the troops/materiel in fully operable condition?

19. Be loaded/unloaded with troops/applicable materiel/fuel/ammunition/wounded personnel?

20. Establish/maintain communications between organizational nodes?

21. Prevent interception/jamming of its communications?

22. Identify and route output to the most appropriate nodes of the organization?

23. Be transported?

SYSTEM CLASS 11 - TARGET ACQUISITION AND/OR DESIGNATOR SYSTEMS

HOW EFFECTIVELY CAN THE SYSTEM:

1. Acquire its targets?
2. Gather the appropriate information about the targets and interpret that information into meaningful data?
3. Predict target behavior?
4. Designate the appropriate targets?
5. Prevent its detection and accurate location?
6. Protect its operator(s)/troops/materiel from small arms fire and minimize the effects of major weapon fire?
7. Be moved, between operations, to minimize the probability of detection/location?
8. Deliver the troops/materiel in fully operable condition?
9. Be loaded/unloaded with troops/applicable materiel/fuel/ammunition/wounded personnel?
10. Establish/maintain communications between organizational nodes?
11. Prevent interception/jamming of its communications?
12. Identify and route output to the most appropriate nodes of the organization?
13. Gather appropriate information?
14. Engage in fire control?
15. Be transported?

S 2.2 Developing Scope

This section provides:

(1) A "Scope Category Index" that describes the categories of scope that relate to issues to be tested, and

(2) A list of conditions that make up each scope category.

The procedure for developing scope is:

(1) Refer to the Scope Category Index and determine which categories apply to the issues to be tested.

(2) Turn to the page in this section that is referenced by the Scope Category Index.

(3) Review the conditions (scope) in the selected scope categories.

(4) Determine the conditions which you feel should make up the scope for the issues you have previously selected. This may be aided by preparing a matrix of operational issues by conditions.

SCOPE CATEGORY INDEX

SCOPE CATEGORY: 1. WEATHER

A. ILLUMINATION

- [ ] (1) Full Sunlight
- [ ] (2) Moonlight
- [ ] (3) Starlight
- [ ] (4) Dusk
- [ ] (5) Overcast, Moonless Night (Pitch Black)
- [ ] (6) Artificial Lighting
- [ ] (7) Flares
- [ ] (8) Direct Glare
- [ ] (9) Indirect Glare (Water, Sand, Clouds, etc.)

B. TEMPERATURE

- [ ] (1) High
- [ ] (2) Low
- [ ] (3) Normal

C. PRECIPITATION

- [ ] (1) Rain
- [ ] (2) Fog
- [ ] (3) Falling/Blowing Snow
- [ ] (4) Sleet
- [ ] (5) Sand Storm
- [ ] (6) No Precipitation

D. WIND

- [ ] (1) High Head Wind
- [ ] (2) High Tail Wind
- [ ] (3) Significant Swirling Wind Gusts
- [ ] (4) Cross Wind
- [ ] (5) No Wind

E. HUMIDITY

- [ ] (1) High
- [ ] (2) Low
- [ ] (3) Normal

SCOPE CATEGORY: 2. TERRAIN

A. GROUND SLOPE

- [ ] (1) Flat
- [ ] (2) Low Positive Hilly
- [ ] (3) Low Negative Hilly
- [ ] (4) High Positive Mountainous
- [ ] (5) High Negative Mountainous

B. GROUND SURFACE

- [ ] (1) Sandy
- [ ] (2) Rocky
- [ ] (3) Loam (Deep Soil)
- [ ] (4) Paved
- [ ] (5) Broken Paved
- [ ] (6) Broken Ground
- [ ] (7) Plowed Fields
- [ ] (8) Bare Packed
- [ ] (9) Vegetation Covered

C. GROUND AND WATER SURFACE

- [ ] (1) Light Mud
- [ ] (2) Heavy Mud
- [ ] (3) Dry
- [ ] (4) Water Covered
- [ ] (5) Ice Covered
- [ ] (6) Snow Covered

D. OBSTACLES

- [ ] (1) Dense Vegetation
- [ ] (2) Light Vegetation
- [ ] (3) Hedge Rows
- [ ] (4) Rivers
- [ ] (5) Manmade Structures
- [ ] (6) Traps
- [ ] (7) No Obstacles

SCOPE CATEGORY: . TARGET

A. TYPE

☐

B. NUMBER

☐ (1) Single Target
☐ (2) Multiple Simultaneous Targets
☐ (3) Multiple Sequential Targets
☐ (4) Combination of Multiple Simultaneous and Multiple Sequential Targets
☐ (5) Noise - Number/% of Targets Within Nontarget Background Clutter

C. LOCATION

☐ (1) Minimum Range
☐ (2) Maximum Range
☐ (3) Normal Range
☐ (4) Azimuth and Elevation Target

D. SPEED

☐ (1) Maximum Speed
☐ (2) Minimum Speed
☐ (3) Cruising Speed
☐ (4) Radical Alterations of Speed
☐ (5) Stationary

E. DIRECTION OF MOTION

☐ (1) Closing
☐ (2) Retreating
☐ (3) Crossing
☐ (4) Complex Maneuver

F. CONCEALMENT

☐ (1) Concealed by Physical Means
☐ (2) Concealed by Electronic Means
☐ (3) Partially Concealed
☐ (4) Concealed by Smoke
☐ (5) Unconcealed

SCOPE CATEGORY: 4. PERSONNEL

A. WORKLOAD

- [ ] (1) When Personnel are only performing this issue
- [ ] (2) When Personnel perform all activities which might occur at the same time this issue is being performed

B. DURATION OF PRECEDING WORK

- [ ] (1) Following No Work
- [ ] (2) Following an Extended Period of Work
- [ ] (3) Following a Normal Period of Work

C. PROTECTIVE GEAR

- [ ] (1) While wearing applicable protective clothing/gear
- [ ] (2) While wearing normal clothing/gear

D. PHYSICAL STRENGTH

- [ ] (1) With Personnel With Minimum Strength
- [ ] (2) With Personnel With Normal Strength
- [ ] (3) With Personnel With Optimum Strength

E. PERCEPTUAL ABILITY

- [ ] (1) With Personnel With Minimum Perceptual Ability(s)
- [ ] (2) With Personnel With Normal Perceptual Ability(s)
- [ ] (3) With Personnel With Optimum Perceptual Ability(s)

F. EXPERIENCE

- [ ] (1) With Personnel With Minimum Experience
- [ ] (2) With Personnel With Normal Experience
- [ ] (3) With Personnel With Optimum Experience

G. APTITUDES

- [ ] (1) With Personnel With Minimum Applicable Aptitudes
- [ ] (2) With Personnel With Normal Applicable Aptitudes
- [ ] (3) With Personnel With Optimum Applicable Aptitudes

H. PHYSICAL SIZE

- [ ] (1) With Personnel of Minimum Size
- [ ] (2) With Personnel of Normal Size
- [ ] (3) With Personnel of Maximum Size

SCOPE CATEGORY: 5. TRAINING

A. INSTITUTION

- [ ] (1) With OJT-Trained Personnel
- [ ] (2) With School-Trained Personnel
- [ ] (3) With Combination OJT and School
- [ ] (4) With Personnel Without Specific Training
- [ ] (5) With Factory-Trained Personnel

B. LATENCY

- [ ] (1) Following a Period of Time Without Specific Training or Practice
- [ ] (2) Immediately Following Training
- [ ] (3) With the Normal Period of Latency

C. TEAM VS. INDIVIDUAL

- [ ] (1) With Personnel Who Have Had Only Individual Training
- [ ] (2) With Personnel Who Have Had Only Team Training
- [ ] (3) With Personnel Who Have Had a Combination of Team and Individual Training

SCOPE CATEGORY: 6. OPERATIONAL

A. CREW

- [ ] (1) With Operational Crew
- [ ] (2) With Minimum Crew

B. HARDWARE

- [ ] (1) With Hardware Fully Up
- [ ] (2) With Partial Breakdown
- [ ] (3) With Hardware Fully Down

C. INFORMATION INPUTS

- [ ] (1) With Full Information Inputs
- [ ] (2) With Partial Information Inputs
- [ ] (3) With No Information Inputs

SCOPE CATEGORY: 7. TACTICS

A. NUMBER OF SYSTEMS EMPLOYED

- [ ] (1) Single System
- [ ] (2) Multiple System of Same Type
- [ ] (3) Multiple Systems of Different Types

B. SPEED

- [ ] (1) Maximum Speed
- [ ] (2) Minimum Speed
- [ ] (3) Cruising Speed
- [ ] (4) Radical Alterations of Speed
- [ ] (5) Stationary

C. LOCATION

- [ ]

D. DIRECTION OF MOTION

- [ ] (1) Closing
- [ ] (2) Retreating
- [ ] (3) Crossing
- [ ] (4) Complex Maneuver

E. CONCEALMENT

- [ ] (1) Concealed by Physical Means
- [ ] (2) Concealed by Electronic Means
- [ ] (3) Partially Concealed
- [ ] (4) Concealed by Smoke
- [ ] (5) Unconcealed

F. CREW PROTECTION

- [ ] (1) Crew Fully Protected-Buttoned Up
- [ ] (2) Crew Partially Protected
- [ ] (3) Crew in Least Protected Configuration
- [ ] (4) NBC Conditions

G. AMOUNT OF AUTOMATIC FUNCTIONING

- [ ] (1) Fully Automatic
- [ ] (2) Semi-Automatic
- [ ] (3) Manual Mode

H. SYSTEM WORKLOAD

- [ ] (1) Overloaded
- [ ] (2) 100% Loaded
- [ ] (3) Operationally Loaded
- [ ] (4) Unloaded

3. PROCEDURE FOR PERFORMANCE TESTING

S3.1 Developing Tasks Required for the Performance of Operability Issues

This section provides:

(1) A "Task Index" that relates categories of operability issues to jobs and tasks required for their performance.

(2) A list of jobs and tasks that apply to each type of operability issue.

The procedure for developing tasks is:

(1) Refer to the Task Index on page S3-2 for each operability issue.

(2) For each issue, determine which category (or categories) of issues apply.

(3) Turn to the page(es) listing the jobs and tasks referenced by the category of issues chosen.

(4) Review the tasks contained in the list that is referenced.

(5) Determine which tasks are absolutely required for success of that issue. In some cases, the tasks listed may be directly usable in defining performance measures. In other cases, the lists may be used as an aid to determine the level and types of tasks that must be obtained.

(6) In the case of unscheduled maintenance, use both the maintenance task list and previous OT and DT results to predict high probability unscheduled maintenance tasks.

TASK INDEX

JOB #1: WEAPON DELIVERY

TASKS

1. Assemble system.
2. Emplace system.
3. Calibrate system components including boresighting and zeroing.
4. Acquire target(s) (This task is dealt with as a separate job. Turn to page S3-4, to complete it.)
5. Select ammunition.
6. Prepare ammunition for firing.
7. Communicate fire order and other intracrew instructions.
8. Fire weapon.
9. Dispose of spent casing(s).
10. Guide weapon to target.
11. Perform misfire procedure.
12. Perform hangfire procedure.
13. Clear/swab/clean appropriate sections of system.
14. Disassemble system.

JOB #2: TARGET ACQUISITION

TASKS

1. Detect target(s).
2. Identify target(s).
3. Select target(s) and target order.
4. Orient weapon system in general firing position.
5. Determine range of target.
6. Aim weapon system. This involves a procedure which results in the system being adjusted for the azimuth and elevation of the target.
7. Illumination or designate target.
8. Adjust aim, following miss.
9. Shift to second target.

JOB #3: WEAPON DELIVERY--GROUND TO GROUND MISSILES

TASKS

1. Mate warhead to missile.
2. Load and secure missile on launcher.
3. Convert transport to launcher.
4. Position and emplace launcher.
5. Lay system for azimuth and elevation
6. Install sighting components.
7. Calibrate system including boresighting and collimating.
8. Conduct missile system prefire checkouts.
9. Arm system.
10. Inspect system for defects.
11. Identify/determine target.
12. Identify/determine target coordinates.
13. Program missile.
14. Initiate firing sequence.
15. Fire system.
16. Guide missile to target.
17. Handoff missile to intermediate guidance.
18. Perform missile no-go procedure.
19. Perform misfire procedure.
20. Perform hangfire procedure.

JOB #4: WEAPON DELIVERY--HAND GRENADES

TASKS

1. Inspect grenade for defects.
2. Correct applicable defects.
3. Attach to appropriate part(s) of person/harness/etc.
4. Acquire target; include the judgment of distance to target.
5. Aim grenade.
6. Launch grenade.
7. Adjust launch based on location of detonation in relation to target.

JOB #5: WEAPON DELIVERY--MINES

TASKS

1. Select appropriate location for mine installation.
2. Inspect mine/triggering device/fusing device.
3. Transport mine.
4. Prepare mine for installation.
5. Install mine (including the digging of a hole).
6. Camouflage mine/triggering device.
7. Aim mine, if applicable.
8. Test circuit(s).
9. Arm mine.
10. Fire mine, if applicable.
11. Disarm mine.

JOB #6: TARGET INFORMATION GATHERING AND INTERPRETATION

TASKS

1. Assemble system.
2. Position system in appropriate location.
3. Select type and number of sensors.
4. Position sensors in appropriate location.
5. Calibrate/align system components.
6. Detect target(s).
7. Identify target(s).
8. Determine number of targets.
9. Determine target(s) location/range.
10. Determine target speed.
11. Determine target direction.
12. Determine target formation/tactical situation.
13. Select and order targets based on the matching of priorities with target information gathered.
14. Recognize countermeasures and take appropriate action.

JOB #7: TARGET DESIGNATION

TASKS

1. Assemble/disassemble system.
2. Calibrate/align system.
3. Select designator system position.
4. Acquire target (see Target Acquisition, page S3-4).

JOB #8: TARGET BEHAVIOR PREDICTION

TASKS

1. Predict maneuver of target(s).

2. Predict location of target(s) after given time interval, or predict time interval to arrive at given location (location includes range altitude, azimuth, elevation, etc.)

3. Predict attack of target(s) on friendly force.

4. Predict time/location for successful attack on target(s).

JOB #9: WEAPON FUNCTION MANAGEMENT

TASKS

1. Determine type of target.
2. Determine speed/direction of target.
3. Determine target range at time of weapon delivery.
4. Determine weather conditions that impact weapon delivery and adjust for them.
5. Determine type of ammunition to be used based on all above factors.
6. Determine probable amount of ammunition required to kill target under existing/projected conditions.
7. Recommend action based on available supply of ammunition, future probable requirements for ammunition, and probable required amount to kill target at various ranges/speeds.

JOB #10:
REPRESENTATION OF TERRAIN/OBSTACLES/INSTALLATIONS/WEATHER

TASKS

1. Indicate key terrain features which might affect outcome of the operation.

2. Indicate man-make obstacles which might affect the outcome of the operation[2].

3. Indicate installations which might affect the outcome of the operation[3].

4. Indicate features of weather which might affect the outcome of the operation[4].

5. Identify important information which is missing.

6. Identify important information which is internally inconsistent or probably inaccurate.

7. Develop alternate information sources.

8. Prioritize information according to user(s) need and probability of its accuracy.

9. Prioritize list of information users for receipt of information based on their functions in this specific operation and their requirements.

---

[1]Your consideration of terrain features should include the following:

coastline configuration
exits from beaches
avenues of approach
cover and concealment
observation and fields of fire
defiladed areas
areas suitable for aviation landing
soil composition
water depth
terrain slopes
beach characteristics
elevations
accessibility of terrain features

[2]Your consideration of man-made obstacles should include the following:

minefields
tank traps
water obstacles
ditches
destroyed/potentially destroyed bridges, tunnels, etc.

JOB #10: REPRESENTATION OF TERRAIN/OBSTACLES/ INSTALLATIONS/WEATHER (CONT'd)

[3]Your consideration of installations should include the following:

- airports
- heliports
- enemy depots
- enemy command posts
- enemy transportation facilities
- enemy communication facilities
- enemy power operation facilities/lines
- enemy C^3 positions
- enemy air defense
- enemy radar facilities
- enemy satellite microwave receiving stations

[4]Your consideration of weather should include the following:

- visibility data
- wind data
- temperature data
- humidity data
- precipitation data

JOB #11: REPRESENTATION OF STATUS OF FORCES

TASKS

1. Indicate location(s) of forces.
2. Indicate composition (number and type) of forces.
3. Indicate availability of forces.
4. Indicate peculiarities/weaknesses of forces.
5. Indicate recent significant tactical events in which specific units were involved.
6. Indicate actions which forces are currently pursuing[1].
7. Indicate the enemy commander(s)' previous behavior in similar situations.
8. Indicate combat effectiveness of forces.
9. Indicate relative combat power of enemy to friendly units.
10. Indicate relevant threat potentials of enemy forces.
11. Identify important missing information.
12. Identify important information which is internally inconsistent or probably inaccurate.
13. Develop alternate sources of information.
14. Prioritize information according to the user(s) needs and probability of its accuracy.
15. Prioritize list of information user(s) for receipt of information based on their functions in this specific operation and their requirements.

---

[1]Your consideration of these actions should include:

direction of movement
speed of movement
apparent purpose(s) of movement

JOB #12: PROJECTION OF BATTLEFIELD OPERATIONS

TASKS

1. Determine observable indicators of possible changes in the operational situation.
2. Prioritize indicators of operational changes.
3. Assign intelligence collection tasks to maximize receipt of indicators according to their priorities.
4. Monitor intelligence collection and reassign tasks based on updated information.
5. Display pertinent information.
6. Identify important missing information.
7. Identify important information which is internally inconsistent or probably inaccurate.
8. Develop alternate sources of information.
9. Determine which model(s) of expected enemy behavior best fits collected information.
10. Assign confidence levels to the projection(s).
11. Make recommendations about the effects of projected operations.
12. Prioritize information according to user(s) needs and probability of accuracy.
13. Prioritize list of information users for receipt of information based on their functions in this specific operation and their requirements.

JOB #13: PROJECTION OF WEATHER CONDITIONS

TASKS

1. Collect relevant weather information for the applicable area(s).
2. Develop alternative weather projections and their indicators.
3. Assign probabilities to weather projections.
4. Determine effects of alternate weather projections on operation(s).
5. Prioritize indicators of weather projections.
6. Assign weather indicator tasks.
7. Monitor weather indicator collection and reassign tasks based on updated information.
8. Update projection probabilities.
9. Collect, order and display pertinent information.
10. Identify important missing information.
11. Identify important information which is internally inconsistent or probably inaccurate.
12. Develop alternate sources of information.
13. Prioritize information according to user(s) needs and probability of accuracy.
14. Prioritize list of information users for receipt of information based on their functions in this specific operation and their requirements.

JOB #14: SELECT THE MOST APPROPRIATE FRIENDLY UNIT(S) TO ENGAGE IN OPERATION

TASKS

1. Determine the requirements the operation will make on the friendly unit.

2. Order these requirements based on commander's priorities.

3. Identify friendly unit(s) with the appropriate mix of attributes to match the prioritized requirements.

4. Determine which friendly units, with the correct attributes, can be removed from their present operations without unacceptable consequences.

5. Determine the transportation systems required to move each friendly unit to the operational area.

6. Determine the availability of each transportation system required to move each friendly unit and the time required for it to perform its function.

7. Determine the logistics required by each friendly unit to perform its functions in the operation in question.

8. Determine the availability of the supplies and delivery systems to the operations area for the required logistics of each friendly unit.

9. Display all significant information and order it in some logical and helpful manner.

JOB #15: SELECTION AND ORDERING OF APPROPRIATE TARGETS

TASKS

1. Locate potential targets.
2. Identify type and number of potential targets.
3. Determine threat potentials of targets.
4. Determine availability of appropriate friendly weapon system.
5. Determine the probability of eliminating target(s).
6. Prioritize targets.
7. Select targets to attack.

JOB #16: CONTROL OF FRIENDLY FORCES ON THE BATTLEFIELD

TASKS

1. Determine commander's desired outcome and priorities.
2. Determine the tactics to be followed.
3. Select the most appropriate friendly unit(s) to engage in operation[1]. (See Select the Most Appropriate Friendly Unit(s) to Engage in Operation, page S3-17.)
4. Determine travel routes for friendly units.
5. Determine departure and projected arrival times for friendly units.
6. Prepare contingency plans and the situations in which each is to be implemented. (See Projection of Battlefield Operations, page S3-15.)
7. Prepare plans, orders, maps, and other required documents.
8. Prepare materials for briefing commanders and staffs.
9. Monitor units' compliance with orders and their progress.
10. Identify critical situations which indicate significant changes in battlefield operations.
11. Update plans/orders as battlefield situation changes.

---

[1]The following types of units should be considered in this selection process:

(1) first echelon
(2) reserve
(3) intelligence
(4) counter-intelligence
(5) maintenance
(6) logistics

JOB #17: LOGISTICS

TASKS

1. Maintain information on current status of supplies.
2. Maintain information on maintenance status of equipment needed for mission.
3. Recommend location of rear boundary bases.
4. Recommend main and secondary supply routes.
5. Determine throughput unit supply requirements.
6. Recommend movements which are consistent with logistics considerations.
7. Develop policies for area damage control operations.

JOB #18: PERSONNEL PLANNING

TASKS

1. Prepare personnel estimate based on requirements of operation.
2. Estimate casualty rates of friendly forces and projected POW's.
3. Prepare evacuation contingency plans.
4. Coordinate personnel replacement plans with appropriate organizations.

JOB #19: RECONNAISSANCE/FIRE CONTROL

TASKS

1. Determine target type/number/size/direction/speed/elevation.
2. Determine weather conditions affecting weapons delivery.
3. Determine target coordinates.
4. Mark target locations; this may be done by physical, chemical, radiological or electronic means.
5. Handoff target(s) to attack units.
6. Determine effects of fire on target.
7. Relocate target(s).
8. Adjust fire of attacking unit(s).

JOB #20: BATTLEFIELD RECONNAISSANCE

TASKS

1. Identify key environmental features.
2. Identify current weather conditions.
3. Identify key elements of threat force .
4. Identify essential information for evaluating NBC contamination hazard outer limits.
5. Identify/select routes.
6. Present information about routes which could influence movement.
7. Identify hazards to movement.
8. Identify early warning of enemy threat.
9. Report map changes.

JOB #21: ESTABLISHMENT AND MAINTENANCE OF COMMUNICATIONS

TASKS

1. Assemble communications device(s).
2. Assemble/erect/orient antenna.
3. Establish communications net.
4. Enter communications net.
5. Transmit messages.
6. Receive messages.

JOB #22: PREVENTION OF INTERCEPTION/JAMMING

TASKS

1. Encode messages.
2. Authenticate transmissions.
3. Decode messages.
4. Apply anti-jamming procedures.
5. Apply transmission security procedures.

JOB #23: INFORMATION ROUTING

TASKS

1. Identify appropriate recipients of information.
2. Prioritize recipients for the delivery of information.
3. Prioritize pieces of information for delivery.
4. Assign security classification and method for maintaining that classification.
5. Determine call signals/frequencies.

JOB #24: VEHICLE MANEUVERING--GROUND VEHICLES

TASKS

1. Observe environment for obstacles, landmarks, etc.

2. Read and use instruments appropriate to vehicle maneuvering

3. Perform the following, moving backward (B) and/or forward (F). Circle B or F as appropriate.

   3.1 Tight turn(s) B F
   3.2 Wide turn(s) B F
   3.3 Accelerating turn(s) B F
   3.4 Decelerating turn(s) B F
   3.5 Rapid acceleration B F
   3.6 Gradual acceleration B F
   3.7 Rapid deceleration (no stop) B F
   3.8 Gradual deceleration B F
   3.9 Sudden stop B F
   3.10 Maintain constant speed B F

JOB #25: VEHICLE MANEUVERING--HELICOPTERS

TASKS

1. Perform takeoff to hover.
2. Perform instrument takeoff.
3. Perform hover checks.
4. Perform hovering turns.
5. Perform hovering flight.
6. Perform normal takeoff.
7. Perform maximum performance takeoff.
8. Perform straight and level flight.
9. Perform climbs and descrnts.
10. Perform turns.
11. Perform instrument turns.
12. Perform acceleration/deceleration.
13. Perform traffic pattern flight.
14. Perform high speed flight.
15. Perform hovering autorotation.
16. Perform standard autorotation.
17. Perform standard autorotation with turn.
18. Perform holding procedures .
19. Perform unusual attitude recovery.
20. Perform before-landing check.
21. Perform shallow approach to a running landing.

JOB #25: VEHICLE MANEUVERING--HELICOPTERS (CONT'D)

TASKS

22. Perform landing from hover.
23. Perform normal landing approach.
24. Perform shallow landing approach.
25. Perform steep landing approach.
26. Perform instrument approach.
27. Perform GCA approach.
28. Perform IFR helicopter recovery procedure.
29. Perform tactical instrument approach.
30. Perform go around.

JOB #26: TACTICAL VEHICLE MANEUVERING--HELICOPTERS

TASKS

1. Perform terrain flight takeoff.
2. Perform hover out of ground effect.
3. Perform terrain flight navigation.
4. Perform contour flight.
5. Perform NOE flight including masking and unmasking.
6. Perform confined area operations.
7. Perform slope operations.
8. Perform pinnacle/ridgeline operation.
9. Perform evasive maneuvers.
10. Perform low-level flight.
11. Perform circling approach.
12. Operate radar warning receiver.
13. Perform visual glide slope approach and landing.
14. Perform ski landing.
15. Perform amphibious operations.

JOB #27: NAVIGATION

TASKS

1. Select appropriate maps and/or navigation aids.
2. Identify present location.
3. Identify destination.
4. Select travel route.
5. Estimate time of arrival and fuel requirements.
6. Travel designated route.
7. Identify position or route at specified times/locations.

JOB #28: VEHICLE LOADING/UNLOADING

TASKS

1. Load and position cargo/passengers in/on vehicle.
2. Secure cargo/passengers.
3. Unload vehicle.
4. Fuel vehicle
5. Load ammunition.

JOB #29: VEHICLE RECOVERY

TASKS

1. Position recovery vehicle(s).
2. Prepare recovery vehicle(s).
3. Prepare system to be recovered.
4. Attach cables between system to be recovered and recovery vehicles.
5. Reconnoiter recovery area.
6. Tow/lift/push system to be recovered.
7. Disassemble/stow recovery equipment.

JOB #30: SELF-RECOVERY

TASKS

1. Prepare system for self-recovery.
2. Reconnoiter for appropriate anchor points and recovery path.
3. Position anchors.
4. Attach cables to anchors/winches.
5. Pull system to safe area.
6. Disassemble/stow self-recovery components.

JOB #31: ESCAPE FROM SYSTEM HARDWARE

TASKS

1. Destroy or alter critical components of communication and other sensitive equipment/documents.

2. Take personal weapon, ammunition, and survival equipment.

3. Position system hardware for escape, if possible under the conditions imposed.

4. Open escape path out of system hardware.

5. Escape from system hardware.

JOB #32: SYSTEM PROTECTION FROM THREAT

TASKS

1. Identify threat to system, e.g., onboard fire, flooding, imminent crash, NBC, enemy attack.
2. Activate hardware protective device(s).
3. Put on protective gear/clothing.
4. Secure material/cargo for protection against threat.
5. Assume protective position for crew/passengers.
6. Maneuver to protect from threat.
7. Deactivate hardware protective device(s).

JOB #33: PREVENTION OF DETECTION/ LOCATION OF SYSTEM

TASKS

1. Detect threat warning(s) which indicate either search or attack modes.

2. Identify the nature of the threat(s) from which detected threat warnings emanate.

3. Take appropriate countermeasures to reduce the probability of identification of location[1].

4. Camouflage system[2].

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[1]These countermeasures include:

jamming
smoke
flares
chaff
powered decoys
signature alteration
electronic attact of threat-sensing equipment

[2]System camouflage includes:

physical
infrared
radar signature reduction

JOB #34: ENGINEERING--OBSTACLE REMOVAL/BREACHMENT

TASKS

1. Acquire obstacle to be dealt with.

2. Prepare system hardware for obstacle removal/breaching. The nature of this preparation is entirely dependent upon the sort of system under consideration. It may involve preparation for bulldozing, gun firing, demolition, etc.

3. Decide on placement of fire, charge, or pressure in relation to obstacle. (See S3-3 and S3-4.)

4. Remove/breach obstacle.

5. Remove/displace remains of obstacle.

JOB #35: ENGINEERING-BRIDGING

TASKS

1. Prepare bridge site.
2. Excavate foundations.
3. Construct bridge abutments.
4. Construct bridge span.
5. Construct/assemble bridge.
6. Prepare bridge for launching.
7. Position bridge transporter for launching.
8. Launch/drive bridge into water.
9. Connect bridge.
10. Recover bridge.
11. Disassemble bridge.

JOB #36: MAINTAIN SYSTEM (Scheduled or Unscheduled)

TASKS

1. Inspect
2. Lubricate
3. Purge
4. Drain
5. Fill
6. Clean
7. Troubleshoot/Diagnose
* 8. Remove
9. Disassemble
10. Assemble
* 11. Install
12. Adjust/Align
13. Test

* If remove and install are impractically small tasks for field test measurement, they may be replaced by--Change/Replace.

S3.2 Determining the Number of Trials and Players

It is important to note that the procedure for determining the number of trials and players is described below in issue terms. Issue performance is a composite of the performance of all tasks that comprise that issue. Therefore, the number of trials and players used to test each issue will be the same as the number of players and trials used to test the component tasks.

In planning an Operational Test, a stage is reached when a decision must be made about the number of trials to be performed for each of the operational issues. If the number of trials is too large, resources are being wasted; if it is too small, the reliability of the test results is significantly reduced. In this context, reliability is the extent to which test results would be repeatable by other subject groups taken from the real population of users.

In essence, there are two related decisions that must be made with regard to the field test. The first is the number of trials each performance unit will perform in the test. The second decision is the number of performance units which will take part in the test.

A performance unit consists of the players needed for a single system to measure the issue. For example, the performance unit for firing a rifle consists of one person, whereas the performance unit for detecting targets in a medium tank may consist of two people (the commander and the gunner).

It is suggested that you try to get statistical assistance from experts regarding the number of trials per performance unit (i.e., a group of players) and the number of units needed to perform each issue under each

set of conditions.* If statistical guidance is not available, use the following general guidelines to determine the number of trials per performance unit, and the number of performance units needed.

To calculate the number of trials and/or the number of performance units for the Operational Test, one has to determine two parameters:

(1) The maximum error permitted for an issue.
(2) The acceptable level of confidence.

Chances are that no sample taken will be an exact representation of the real population that will use the system in question. For this reason, the statistics taken on the sample population will probably provide somewhat different results than you would obtain by using that entire population. The difference between the results from the sample population and those from the entire population is the error. In general, as the size of your sample increases, and therefore becomes more like the real population, the error will decrease; however, your testing expenses will increase. For this reason, you have to decide on the maximum acceptable size of this error; that is, the difference between sample and entire population results that is acceptable. Suppose you have decided that you can permit a maximum error of five percent between sample population testing results and real population results; you then have to decide how much confidence you must have that your results will not exceed this error. This is the level of confidence you require. It is expressed as a percentage. For example, you may decide that

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*Box, G., Hunter, W., Hunter, J. Statistics for Experimenters New York, John Wiley and Sons, 1978.

Cohen, J. Statistical Power Analysis for the Behavioral Sciences, New York, Academic Press, 1969.

Kirk, R. Experimental Design: Procedures for the Behavioral Sciences, Belmont, CA, Brooks/Cole, 1968.

you must be 90% confident that your results will not exceed a five percent error. The higher the minimal acceptable level of confidence, while holding the error constant, the larger the sample population will have to be. Consequently, you will need a larger number of trials per player (or performance unit) and a larger number of players (or performance units) in the Operational Test.

The following procedure applies to the measure of each issue under a specific set of conditions. Therefore, if a measure is to be calculated for each condition set of an issue separately, the number of trials and performance units applies to each condition set separately. If, on the other hand, you will aggregate your measures across condition sets, then the number of trials and performance units applies to all the condition sets together. In this case, it will be necessary to divide the number of trials equally between the aggregated sets of conditions.

(1) Decide on the number of trials per performance unit for each issue under each condition set.

It has been determined, based on experimental statistical research, that at least five trials for each performance unit should be used in an Operational Test.** This will supply the minimum amount of data necessary to meet the statistical assumptions underlying the determination of sample sizes. If less than five trials are used, the determination of sample size becomes more tenuous.

** Crolotte, A. Cours de Statistique, Faculté des Sciences Economiques (2 ème anée) Universite Nationale Gabonaise, Libreville, 1974.

We will supply you with tables based on the assumption that you will use five trials per unit. However, we will also supply you with a formula to use if you decide on more or fewer than five trials per unit.

Note: It is not recommended that you use more than ten trials per unit.

(2) Decide on the number of performance units to be used to test each issue under each condition set. This decision depends on whether the statistic used for this issue is a percentage or an average. We will discuss each in turn.

Percentage Statistics

(a) Decide which confidence level is acceptable. Conventionally, 95% is selected as the appropriate confidence level for rigorous experimentation, but in the case of Operational Testing, a lower confidence level may be acceptable. The lower the confidence level selected, the fewer performance units you will require.

Table S3-1 includes the 95%, 90%, 85%, and 80% confidence levels. No matter which confidence level you select, it must be the same for all statistics of a given issue. You may use the same confidence level for all issues. However, if some issues require a higher confidence level than others, you may wish to define a higher confidence level for those issues. This will affect the size of the player populations used.

(b) Determine the maximum error, in terms of percentage points, that is acceptable. For example, if you accept an error of five percentage points, then, with your level of confidence, you could say that the real population value is within ± five percentage points of the result obtained during the Operational Test which used only a sample from that population. Of course, the larger the error you accept, the less meaningful your data will become. However, as the error permitted increases, the number of performance units required decreases.

(c) Table S3-1 indicates the number of performance units required, given various error and confidence levels. The table was constructed assuming five trials per performance unit, and the largest reasonable variance for the statistic. If fewer than five trials per unit are to be used, go to the next instruction to determine the number of units required.

Table S3-1
NUMBER OF PERFORMANCE UNITS REQUIRED

ERROR	CONFIDENCE LEVEL			
	95%	90%	85%	80%
05%	77	55	42	33
10%	20	14	11	8
15%	9	6	5	4
20%	5	4	3	2

(d) If five trials per performance unit are not used, the number of performance units required can be computed using the following formula.

Note: The use of more than ten trials per unit is not recommended.

$$N = \frac{k}{(error^2) \times n}$$

where:

N = Number of performance units required.
Error = Maximum error acceptable (in percentage points).
n = Number of trials per performance unit.
k = Is a constant which depends on the confidence limit, as follows:

CONFIDENCE LEVEL	k
95%	9604
90%	6806
85%	5184
80%	4096

Example: If there are ten trials per unit and you wish to be 90% confident that test results will be within ± 5 percentage points of the real population mean:

$$N = \frac{6806}{(5)^2 \times 10} = 27.2 \text{ therefore 28 performance units}$$

(e) Determine which confidence level is acceptable. See instruction (a) above for explanation.

(f) Determine the maximum error that is acceptable. For example, if you were measuring time to unload a truck, the maximum acceptable error might be 20 minutes. Be sure to express the error in the same units as the average (i.e., minutes, hours, etc.). With your level of confidence, you could then say that the real population average loading time would be within ± 20 minutes of the average obtained during the Operational Test.

(g) Estimate the maximum variance expected for a unit across its trials. A unit's performance will vary from trial to trial. The variance we are interested in is the variability of the most variable or erratic unit you foresee using in the Operational Test. Thus, variance can be estimated using one of the following three methods. These are listed in order of preference:

METHOD I. Pilot Study.

Perform a pilot study with a representative unit and calculate the variance across trials using the following formula. A minimum of five trials should be used.

$$\text{Variance} = \frac{\sum X^2 - \frac{(\sum X)^2}{n}}{n-1}$$

where:

n = the number of trials performed by the unit.
X_i = the outcome of performance for trial i.

METHOD 2. Previous Data.

Estimate the variance of a unit across trials by examining data collected from a similar system, or an earlier OT of the same system.

METHOD 3. Expected Range.

Estimate the variance of a unit across trials by estimating the range of performance across trials and using the following formula. (Note: This formula assumes that performance of a unit is normally distributed across trials.)

$$\text{Variance} = \frac{(\text{Range})^2}{16}$$

where:

Range = highest expected value - lowest expected value

(h) Calculate the number of performance units required using the following formula:

$$N = \frac{kV}{n(\text{error})^2}$$

where:

N = Number of performance units required.
V = Maximum variance of a unit across trials.
error = Maximum acceptable error.
n = Number of trials per unit (minimum 5 recommended)
k = Constant whose value depends on confidence level selected:

CONFIDENCE LEVEL	k
95%	3.84
90%	2.72
85%	2.07
80%	1.64

Example: For time to load truck, using five trials per unit, and an estimated maximum variance of 100 minutes. If you wish to be 90% confident that the test mean will be within ± three minutes of the real population mean, then:

$$N = \frac{(2.72)\ (100)}{(5)\ \ (3^2)} = 6 \text{ performance units}$$

S3.3 WORKSHEET FOR PLANNING DATA COLLECTION

(1) Are measures best taken by an:

Observer	Instrumentation	Combination of Both
☐	☐	☐

If you selected Observer, or Combination of Both, continue with 2.

(2) Is there space for an observer without significantly disturbing the performance you want to measure?

YES	NO
☐	☐

If the answer to this question is no, you will probably have to collect your data with instrumentation; turn to Step 18.

(3) What sort of background (previous training, experience, MOS, etc.) will be required of the observer(s)?

_____

_____

_____

(4) How many observers, with this background, will be required to measure performance?

(5) What is the source of observers with appropriate backgrounds?

(6) How long in advance of the OT must you begin to arrange for the availability of these observers?

(7) What date will this be?

(8) What sort of training will be required for the observers?

(9) Who will provide this training? The answer to this question may be obvious if there are OT personnel who have been dedicated to observation training. If the answer is not obvious, you should consider repeating Steps 2-8 substituting the words "observer trainer" for the word "observer."

(10) What sort of materials, equipment, and information will be required for the observer training?

(11) Who will supply observer training material?

(12) How much lead time is required for the development of observer training material?

Date development must begin -

Date all material must be completed -

(13) Where will observer training take place?

(14) How long will observer training take?

(15) What kind of Data Collection Forms (Checklists, etc.) will be required?

(16) Who will produce these forms?

(17) By what date must these forms be completed?

_____

_____

If you selected Instrumentation or Combination of Both continue with Step 18.

(18) What kind(s) of instrumentation is required to obtain the necessary data?

_____

_____

_____

(19) Is there space for the instrumentation without significantly disturbing the performance criteria you want to measure?

YES	NO
☐	☐

If the answer to this question is no, and there is also inadequate space for an observer, you will have to either:

(1) Switch to another variety of instrumentation,
or
(2) Collect this information through debriefing.

(20) Is there adequate power for the device?

YES ☐ NO ☐

If the answer to this question is no, you will have to either:

(1) Switch to another variety of instrumentation,
or
(2) Provide another source of power,
or
(3) Use an observer to collect data,
or
(4) Collect this information through debriefing.

(21) Is the instrumentation available to you? To answer this question adequately, you will first have to find out:

(1) If it already exists

YES ☐ NO ☐

(2) Where it can be obtained

_____

_____

(3) The lead time for obtaining it

_____

_____

(4) How long it takes to install it in your System

_____

_____

If the answer is no, you will have to

(1) Switch to another variety of instrumentation,
or
(2) Use an observer to collect data,
or
(3) Collect this information through debriefing.

(22) Are installation and maintenance of the instrumentation going to require technicians dedicated to this project?

YES ☐ NO ☐

The answer to this question may be obvious if there are OT personnel who have already been dedicated to this function. If the answer is not obvious, you should consider repeating the most applicable of Steps 2-8 substituting the word technician for observer.

If you selected Combination of Both, all questions from 2-22 apply to you. In addition answer:

(23) Is there enough space, for both the observer and the instrumentation, without significantly disturbing the performance criteria you want to measure?

YES ☐ NO ☐

If the answer to this question is no, you will have to:

(1) Switch to another form of instrumentation,
or
(2) Remove either the observer or the instrumentation,
or
(3) Collect this information through debriefing.

4. COLLECTING ADDITIONAL DATA DURING OT

S4.1 OBSERVER AND PLAYER CHECKLIST

This section contains an observer and player checklist to be used to collect detailed data describing the reasons for task difficulty. This checklist may be used as written, or individual items may be used in specifically tailored checklists.

OBSERVER AND PLAYER CHECKLIST

ISSUE:_____

TASK:_____

MANIPULATION DIFFICULTY

Check any problems encountered when trying to manipulate the control(s), or any other piece of equipment, during the performance of this task:

___ Too hard to move, too much effort required.
___ Movement required unreasonable amount of dexterity.
___ Too many other things required at same time.
___ Too easy to make a mistake.
___ Movement different from what is reasonable to expect.
___ Movement requires unavailable tool(s).
___ Other, specify:_____

REACH/ACCESSIBILITY

Check any problems encountered when trying to reach the control(s) or any other piece of equipment that had to be manipulated during this task:

___ Too far away to reach comfortably.
___ Angle to it was such that it could not be reached comfortably.
___ It was fully or partially blocked by another object.
___ It was fully or partially blocked by another person.
___ Reaching it forced exposure to hazardous or highly uncomfortable objects (excessively hot, excessively cold, sharp, etc.).
___ Other, specify:_____

CONTROL CONFIGURATION

Check any problems encountered with the configuration of the control(s), or any other piece of equipment that had to be manipulated, during this task:

___ Too hard to find.

___ Too hard to determine what it was.

___ Too close to other control/equipment.

___ Too far from other control/equipment used in same performance.

___ Used without looking at it much, and it felt too much like others.

___ Too hard to tell when it was activated or moved to correct position.

___ Other, specify:_____

WORKSTATION DESIGN FOR VISION

Check any visibility problems encountered during this task caused by the workstation:

___ Not enough light on outside of work station.

___ Window/port not big enough.

___ Window/port not in right place.

___ Window/port too dirty or distorted.

___ Equipment/people in the way of window/port.

___ Not enough light inside work station.

___ Too much glare.

___ Important equipment behind other equipment or people.

___ Viewing angle from seat to equipment not good.

___ Other, specify:_____

NOISE

Check any noise problems encountered during this task:

___ Could not hear radio.
___ Could not hear other crew members.
___ Noise produced fatigue.
___ Noise disturbed concentration.
___ Noise produced discomfort.
___ Noise gave away location.
___ Other, specify:_____

MOTION

Check any motion problems encountered during this task:

___ Vibration affected accurate use of controls.
___ Vibration affected accurate reading of displays.
___ Constant vibration produced fatigue.
___ Vibration affected detection/identification of objects outside the workstation.
___ Acceleration too great for the kind of seat support.
___ Acceleration prevented reaching control.
___ Acceleration prevented seeing display.
___ Kind of motion nausea.
___ Other, specify:_____

VENTILATION:

Check any ventilation problems encountered during this task:

___ Much too hot.
___ Much too cold.
___ Much too humid.
___ Not enough fresh air flow.
___ Exhaust fumes too strong.
___ Gun/rocket fire products too strong.
___ Bad odors produced nausea.
___ Other, specify:_____

What was the effect of ventilation in the workstation on the performance of this task:

WORKSTATION DIMENSIONS

Check any problems with the dimensions of the workstation encountered during this task:

___Work surface too small.
___Work surface in wrong place.
___Work surface at wrong height or angle.
___Not enough space to work because of equipment, or space allowed.
___Not enough space to work because of other crew members.
___Poor arrangement of equipment.
___Hatches too small.
___Hatches in wrong places.
___Other, specify:_____

SEATING

Check any seating problems encountered during this task:

___Seat too narrow.
___Seat at wrong height.
___Not enough back support.
___Seat back angle not right.
___Needs arm supports.
___Needs foot supports.
___Not enough head space.
___Not enough shoulder space.
___Not enough leg space.
___Not enough foot space.
___Seat does not absorb vibrations well enough.
___Seat uncomfortable and makes you tired.
___Seat needs to move or move more.
___Other, specify:_____

SAFETY HAZARDS

Check any safety hazards encountered at the workstation during this task:

___ Sharp, jagged, pointed object(s).
___ Dangerous lack of head clearance.
___ Dangerously hot material exposed.
___ Source of electric shock exposed.
___ Poisonous material exposed.
___ Moving machinery exposed.
___ So little light that accident could result.
___ Glare so bright that accident could result.
___ Dangerously high noise level.
___ Dangerous lack of ventilation.
___ Anchoring of equipment not adequate.
___ Padding of equipment not adequate.
___ Crew seat belts/restraints not adequate.
___ Slippery walking or climbing surface.
___ Handholds for lifting or climbing not adequate.
___ Footholds for climbing not adequate.
___ No adequate signal when equipment operation becomes dangerous.
___ No adequate signal when outside situation becomes dangerous.
___ Other, specify:_____

TRAINING METHOD

How was this task trained?

___ Lecture.
___ Film or other audio-visual method.
___ Reading printed material.
___ Paper and pencil workbook.
___ Practice in a simulator.
___ Watching someone doing it.
___ Doing it yourself with the actual hardware.
___ Other, specify:_____

5. EVALUATION

No procedures are included in this chapter
of the HRTES Supplement

6. ANALYSIS

CONTENTS:

TASK EVALUATION WORKSHEET

SYSTEM TESTED: _____

OT: _____ DATE OF TEST: _____ EVALUATOR: _____

PHONE # OF EVALUATOR: _____

TYPE OF ANALYSIS: TRAINING : HFE : PERSONNEL SELECTION

TASKS TO BE ANALYZED	CONDITIONS IN WHICH EACH TASK PERFORMED INADEQUATELY

TRAINING MEASURES

CONTENTS:

GENERAL INSTRUCTIONS FOR TRAINING MEASURES

DESCRIPTION: An operational test (OT) has been completed recently. For the specifics of this OT see the "Task Evaluation Worksheet" of this submission. Various operator and maintainer tasks were measured during this OT. One or more of these tasks were evaluated as having been performed inadequately.

Operational testing and evaluation personnel have determined that those tasks that are listed are of significant importance to the overall evaluation of the system that was tested. They need to know <u>why</u> these tasks were performed inadequately. One possible reason is that the <u>training</u> of these tasks was in some way inadequate.

Now you will have to decide which of the measures to take for each task. During the OT, players and observers filled in questionnaires in which they gave their opinions of the difficulty of each tasks and the reasons for significant difficulty. The questionnaire scores may be helpful to you in deciding which training measures to take. If a score indicates significant difficulty, it is reasonable to take the corresponding training measure for that task. It is, of course, possible that players and observers were not able to judge whether there was something about training which was inadequate and produced inadequate task performance. Therefore, these scores, if they are available, can only be a guide for you to use as you think best.

(1) Examine the player and observer questionnaires for the collected tasks. Use these questionnaire data as an aid to selecting parallel training measures. If you do not have one or more such questionnaires, use your best judgment for deciding which measures to take of each task.

(2) When you are finished taking the measures you have selected for each task, make as many copies of the "Summary Worksheet for Training Analysis as you need for the tasks you have diagnosed (one per task).

(3) Fill in the information at the top and extreme bottom of each worksheet.

(4) Record the Indices of Adequacy for each training measure you have taken for each task being diagnosed. This is to be done in the appropriately labeled boxes on the worksheets.

(5) If you have not taken a specific training measure for a given task, and if you have questionnaires for that task, use the appropriate questionnaire scale score as an Index of Adequacy. Record this questionnaire based score(s) in the appropriately labeled box.

(6) If you have not taken a specific training measure for a given task, and if you do not have a questionnaire for that task, record an "X" in the appropriate box.

(7) Next to each Index of Adequacy record an "EXP or "QUEST" in the third column of the worksheet. "EXP" is recorded next to an Index which was based on an expert measure you have taken. "QUEST" is recorded next to an Index which was based on a questionnaire scale.

(8) Record the specific training problem(s) which caused any Index of Adequacy to be significantly below 100. This is to be done in the first column of the worksheet.

(9) Compute the mean of Indices of Adequacy for each task diagnosed. If you have recorded an "X" in any box, leave it out of the computation. Record the mean in the Training box at the extreme right of the worksheet.

(10) When you have completed the training measures and the "Summary Worksheet for Training Analysis" return all materials to the sender.

NOTE: Two of these measures require data that should be collected in the "OT Training Data Collection Worksheets." Ideally these worksheets should be completed by OT training personnel during, or immediately after, OT training.

GUIDELINES FOR COMPLETING OT TRAINING DATA COLLECTION WORKSHEET

You are asked to record the amount of time required for training. This package includes the Guidelines you are reading; a list of tasks that you trained; and the "OT Training Data Collection Worksheet." Immediately following OT Training, fill out the "OT Training Data Collection Worksheet." The following instructions will aid you in completing the Worksheet:

(1) List the tasks you trained in the left-hand column of the Worksheet. Examine the enclosed list of tasks and select those you have trained.

(2) Potential training/practice methods are listed on the matrix edge. If you used a method not listed, add it.

(3) Each cell should be filled in with the number of hours or fraction of hours used to train each task according to each training method.

(4) Add across each row to determine the "sum" of total training and practice time for a given task.

(5) Return the Worksheet to the sender to be included with other test documentation.

OT TRAINING DATA COLLECTION WORKSHEET

In each cell, record the training time for each training method listed, in hours or fractions of an hour.

TASKS TRAINED	TRAINING METHODS: ORAL/WRITTEN DRILL/ PRACTICE	LECTURE	INDIVIDUAL DISCUSSION	GROUP DISCUSSION	READING TEXTS	EXPERT DEMONSTRATION/ VISUAL AIDS	PROGRAMMED INSTRUCTION	GAMES	SIMULATION	HANDS-ON PRACTICE/ REAL HARDWARE	SUM

TRAINING MEASURE #1
MEASURE OF TRAINING TIME ALLOCATION (ALTERNATIVE 1)

DESCRIPTION: This measure compares the length of time devoted to training the task that is being diagnosed with the length of time devoted to training a baseline task. To use this measure the following requirements must be met:

(1) You must have access to a task list for a functionally similar system.
(2) This list must contain a similar task. Usually this will be the system being replaced by the one which has been tested.
(3) You have no reason to suspect that the baseline task is significantly more difficult to perform than the task being diagnosed.
(4) You have access to data which includes the length of time devoted to training this baseline task.
(5) You have no reason to suspect that this baseline task was performed in an unsatisfactory manner.
(6) You have no reason to suspect that the personnel who performed the baseline task had inferior aptitudes to those who performed the task being diagnosed.
(7) The training of the task being diagnosed has not improved in a way that would require less training time than the baseline task.

If you have this information, the task can be used as a baseline for training time. Under these circumstances it would be plausible to assume that the task being analyzed should have received at least as much training

time as the baseline task. However, this required information will probably not be available in the early tests in which HRTES is used. As HRTES continues to be used, this required data should become available.

PROCEDURE:

(1) Determine if you can meet all seven requirements for the use of this measure. If not, read alternative #2. If you can meet them, copy "Worksheet for Training Time Allocation Measure (Alternative 1)" on page S6-15 for tasks to be diagnosed.

(2) Fill in the required information on your copy of the worksheet.

(3) Divide the training time of the task being diagnosed by the training time of the baseline task, and record it. If the resulting quotient is greater than 1.0, record it as 1.0. A number larger than this provides no additional diagnostic information.

(4) Multiply the resulting quotient by 100, and record it on the worksheet. This is what HRTES refers to as the Index of Adequacy for this measure of training time. The further this Index is below 100, the greater the likelihood that insufficient time was devoted to training the task.

WORKSHEET FOR TRAINING TIME ALLOCATION MEASURE
(ALTERNATIVE 1)

TASK BEING ANALYZED: _____

_____

SIMILAR BASELINE SYSTEM: _____

_____

BASELINE TASK: _____

_____

TRAINING TIME FOR DIAGNOSED TASK: _____

TRAINING TIME FOR BASELINE TASK: _____

ANALYZED TASK/BASELINE TASK (1.0 MAXIMUM) = _____

INDEX OF ADEQUACY FOR TRAINING TIME

(MULTIPLY QUOTIENT ABOVE BY 100) = _____

TRAINING MEASURE #1
MEASURE OF TRAINING TIME ALLOCATION (ALTERNATIVE 2)

DESCRIPTION: The amount of time spent training a task ought to be related to its criticality and difficulty. This measure requires the determination of the criticality and difficulty of a task that is being diagnosed and of five randomly selected tasks that were successfully performed. Criticality and difficulty of tasks is determined by rating.

Once you have determined the criticality (C) and difficulty (D) of each of the six tasks, you calculate the training time per unit of criticality X difficulty (T/CXD) for each. You then compare this statistic for the task being diagnosed with the mean of this statistic for the five successfully performed tasks. If the training time of the task being diagnosed was insufficient, there should be a significant difference between its statistic and the mean statistics. If such a significant difference does not exist, you cannot assume a training time insufficiency. In this measure a significant difference is defined as one standard deviation.

PROCEDURE:

(1) Select five tasks that were successfully performed in this OT (to accompany the one unsuccessfully performed task that is being analyzed).

(2) Rate the difficulty, criticality for each of the six tasks on the accompanying scales.

DIFFICULTY

1	25	50	75	100
Task not at all difficult to perform		Task moderately difficult to perform		Task extremely <u>difficult</u> to perform

CRITICALITY

0.1	.25	.5	.75	1.0
If task not performed, no effect on system capability		If task not performed some impact on system performance, but success possible		If task not performed, system fails

(3) You now have six tasks, and each one has a criticality and a difficulty weight. Multiply these two weights for each task, and record the products in the appropriate cells of the "Training Time Allocation Measure Alternative 2 Worksheet."

(4) Retrieve the "OT Training Data Collection Worksheets" completed by the Trainers during this operational test. Copy the training time for each task from this worksheet on to your "Training Time Allocation Measure (Alternative 2) Worksheet."

(5) Divide each task's training time by its criticality X difficulty product, and record the resulting quotient on the worksheet.

(6) Compute the mean of quotients from Step 5. However, this is the mean only for <u>successfuly</u> performed tasks.

(7) Compute the standard deviation of the last (fourth) column for only the successfully performed tasks. Enter it in the standard deviation box.

Standard Deviation Formula:

$$SD = \frac{\sum (X-\overline{X})^2}{N-1}$$

Where:

X = the values in column 4 of the worksheet for the successfully performed tasks.

$\overline{X}$ = column 4 mean of the successfully performed task.

N = number of successfully performed task's listed on the worksheet.

(8) If the quotient ($\frac{\text{Training Time}}{C \times D}$) of the task being analyzed falls within one SD of the mean of the successful tasks, record 100 for the Index of Adequacy. In this case it is impossible to assume that training time was unacceptable.

(9) If this quotient does not fall within one SD of the mean:

(a) Divide the quotient of the task being analyzed by the mean quotient (from Step 6).

(b) Multiply the resulting quotient by 100.

(c) This is the Index of Adequacy. The farther it is below 100, the greater the chance that training time was inadequate.

TRAINING TIME ALLOCATION MEASURE
ALTERNATIVE 2 WORKSHEET

SUCCESSFULLY PERFORMED TASKS	CRITICALITY × DIFFICULTY (2)	TRAINING TIME (3)	(3) + (2)

UNSUCCESSFUL TASK			

MEAN

STANDARD DEVIATION

INDEX OF ADEQUACY

TRAINING TIME ALLOCATION MEASURE
ALTERNATIVE 2 WORKSHEET

EXAMPLE FOR MEASURE ALTERNATIVE 2

SUCCESSFULLY PERFORMED TASKS	CRITICALITY × DIFFICULTY (2)	TRAINING TIME (3)	(3) ÷ (2)
1. Select target and target order.	.6 X 30 = 18	8 hrs	.44
2. Perform misfire procedure.	.3 X 70 = 21	8 hrs.	.38
3. Fire weapon.	.5 X 1.0 = .5	5 hrs.	10.0
4. Perform ground vehicle maneuvers.	.3 X 60 = 18	8 hrs.	.44
5. Fuel ground vehicle.	.1 X 10 = 1.0	2 hrs.	2.0
UNSUCCESSFUL TASK			
1. Detect and identify target.	.6 X 80 = 48	1 hr.	.02

MEAN	.85
STANDARD DEVIATION	.69
INDEX OF ADEQUACY	2.35

TRAINING MEASURE #2
MEASURE OF THE ADEQUACY OF PRACTICE CONDITIONS

DESCRIPTION: The amount and nature of practice is likely to have a considerable effect on the adequacy of task performance. If a task were performed inadequately under a given condition or set of conditions, and if you discovered that it had not been trained under these conditions, you might suspect that this practice had been inadequate. Further, you might suspect that such an inadequate practice was a cause of the inadequate performance of the task. This measure is based on expert opinion of the adequacy of practice which took place for the task being analyzed. The individual who produces this expert opinion should know:

(1) what conditions were in force during task practice;
(2) the amount of time devoted to practicing various tasks;
(3) the number of practice trials for each task; and
(4) how the practice was carried out in terms of realism.

PROCEDURE:

(1) Complete all "Practice Condition Worksheets," by answering the questions and determining the appropriate rating.

(2) If more than one condition was in force for an inadequately performed task, make an additional copy of the blank "Practice Condition Worksheet." Write "Mean" in the "Condition Box."

(3) Compute the mean ratings of all conditions rated for each task being analyzed. Record this in the "Rating Box" of the Mean Worksheet. This is the Index of Adequacy of Practice Conditions for this task. The further it is below 100, the less adequate the total practice for this task.

(4) If any condition received a rating of zero because both questions 1 and 2 were answered "NO," it should be specifically noted. Even though adequate practice of a number of other conditions may raise the final Index, the presence of any zero could point to the actual cause of inadequate performance. Therefore, when the overall Index is reported, the total absence of a condition in practice or the absence of its "good replacement" should also be reported as a possible cause.

PRACTICE CONDITION WORKSHEET

TASK: _____

CONDITION: _____

1. Was the above task practiced under the above condition?

2. If the answer to number 1 was "NO," was there a condition that was a good substitute?

   If the answer to this question is "YES," list the substitute condition here ——→ _____

3. If the answer to either questions 1 or 2 was "YES," fill out the rating form below, and return the complete worksheet to sender.

   If the answer to both questions 1 and 2 was "NO," ignore the rating form below, and return it to sender.

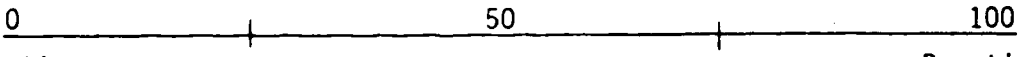
PRACTICE CONDITION RATING FORM

Rate the quality of the practice of the task under this condition (or substitute condition).

This rating should include your consideration of the adequacy of:

(1) Practice time
(2) Number of practice trials
(3) Realism of practice.
(4) Realism of practice hardware/software.

Your rating is to be made on the scale, as indicated here. Any number between 0 and 100 can be given.



Practice Completely Inadequate

Practice Completely Adequate

ENTER YOUR RATING HERE ——→ [ ]

TRAINING MEASURE #3
MEASURE OF COMPATIBILITY OF TRAINING METHODS AND SKILLS REQUIRED FOR THE TASK

DESCRIPTION: When someone performs a task, he or she is simply exercising one or more skills. The level of the skills will have a significant effect on the task's level of performance. Skill level is the outcome of a combination of training and the characteristics of the individual. Training to enhance skill level is, itself, a combination of previous formal and informal training and current training directed toward the specific system being tested.

All training methods are not equally good at training all types of skills. Each type of skill has one or more particularly applicable training methods. The less appropriate the training method used, the higher the probability that the skill will not be enhanced. If a task being analyzed required skills that were trained by inappropriate methods, you would have reason to suspect that these skills were not adequately enhanced. Further, you might suspect that this was a cause of inadequate task performance. To aid you in understanding this measure, a complete set of examples has been included.

PROCEDURE:

(1) Retrieve the "OT Training Data Collection Worksheets" for the tasks being analyzed.

(2) Examine the appropriate "OT Training Data Collection Worksheet" for the task. Copy the percentages of training time devoted to each training method from the above worksheet to the right-hand column of Worksheet #1.

(3) Examine Worksheet #2 for the task being diagnosed, and determine which of the six global skill types listed are required for the performance of this task.

(4) When you have decided which skill types are required, estimate the percentage of each required skill that must be present in the performance of this task. These percentages must sum to 100. Record the percentages in the appropriate column of Worksheet #2.

(5) Next, you must estimate the utility of each training method that was actually used in the training of each required skill (for this task). Training methods not actually used and skills not required will not play a part in this utility rating procedure. There are two alternative methods for making this estimate of training method utility for skills:

(a) Complete the "Utility Estimate Worksheet," for the system which was tested in the OT. This will be time consuming and somewhat difficult, but it will represent your thinking (or the thinking of some other individual who you get to complete this worksheet); or

(b) Obtain utility ratings from Table 6-1. The utility ratings in this table were made by training experts, and were based on synthesis of a large body of applicable research.

(6) One way or another, you now have determined the utility of each training method, actually based, for training each

TABLE 6-1

EXPERT'S UTILITY ESTIMATES

TRAINING METHODS	SKILLS					
	KNOWLEDGE	UNDERSTANDING	VERBAL/WRITTEN	PSYCHOMOTOR	PERCEPTUAL	DECISION MAKING
ORAL/WRITTEN DRILL PRACTICE	1.0	.5	.1	.1	.1	.1
LECTURE	.7	.7	.3	.1	.1	.1
INDIVIDUAL DISCUSSION	.7	1.0	.9	.3	.3	.8
GROUP DISCUSSION	.4	.9	.7	.2	.1	.7
READING TEXTS	.8	.7	.3	.1	.1	.1
EXPERT DEMONSTRATION/VISUAL AIDS	.5	.7	.2	.2	.7	.3
PROGRAMMED INSTRUCTION	.8	.8	.5	.4	.2	.3
GAMES	.3	.6	.8	.8	.7	.5
SIMULATION	.2	.6	1.0	.9	.8	.8
HANDS ON PRACTICE--REAL HARDWARE	.5	.6	1.0	1.0	1.0	.6

required skill. Enter these utility ratings in the appropriate cells of Worksheet #1 for the task being analyzed. Only enter the utility ratings for those skills actually required (from Worksheet #2), and for those training methods actually used.

(7) Copy the percentages required for the performance of the skills (from Worksheet #2) into the appropriate cells of the bottom row of Worksheet #3. Skills which received no rating or a zero percentage are to be left blank.

(8) Return to Worksheet #1. Multiply each number in the right-hand column of this worksheet by each of the ratings by each of the ratings in the row to which that first number belongs. You are now multiplying the percentages of training time of each training method by the utility rating of each skill required for the performance of the task.

(9) Record the products of the multiplication in procedure 10 in the appropriate cells of Worksheet #3. You may find it helpful to examine the various example worksheets at this point.

(10) Sum the products in each column of Worksheet #3, and record each column's sum in the second to the last row of this worksheet ("Sum of Column" row).

(11) Compute the correlation coefficient between the last two rows of Worksheet #3. These are the "Sum of Column" row and the "% Of Task Involving Skill" row. If you have to do this computation by hand, use the following formula:

Computational Formula for Correlation Coefficient:

$$r = \frac{N \sum XY - (\sum X)\ (\sum Y)}{\sqrt{[N \sum X^2 - (\sum X)^2][N \sum Y^2 - (\sum Y)^2]}}$$

Where:

r = correlation coefficient.
N = number of skills listed in Worksheet #3.
X = column sum (second to last row in Worksheet #3).
Y = percent of task involving skill (last row of Worksheet #3).
$\sum$ = sum over the skills in Worksheet #3.

(12) Record the resulting correlation coefficient in the appropriate box of Worksheet #3. This will be either a positive or negative number from 0 to 1.0. The closer it is to 1.0, the more appropriate were the training methods and times alloted to them in the training of the task.

(13) Multiply the correlation coefficient by 100, and record the resulting product in the Index of Adequacy box of Worksheet #3.

TRAINING METHODS WORKSHEET #1

TASK

TRAINING METHODS	SKILLS						
	KNOWLEDGE	UNDERSTANDING	VERBAL/WRITTEN	PSYCHOMOTOR	PERCEPTUAL	DECISION MAKING	% OF TASK TRAINING TIME USING THIS METHOD
ORAL/WRITTEN DRILL/PRACTICE							
LECTURE							
INDIVIDUAL DISCUSSION							
GROUP DISCUSSION							
READING TEXTS							
EXPERT DEMONSTRATION/VISUAL AIDS							
PROGRAMMED INSTRUCTION							
GAMES							
SIMULATION							
HANDS ON PRACTICE — REAL HARDWARE							

TRAINING METHODS WORKSHEET #1

EXAMPLE

TASK: Detect and identify target

TRAINING METHODS	SKILLS: KNOWLEDGE	UNDERSTANDING	VERBAL/WRITTEN	PSYCHOMOTOR	PERCEPTUAL	DECISION MAKING	% OF TASK TRAINING TIME USING THIS METHOD
ORAL/WRITTEN DRILL/PRACTICE							
LECTURE	.7				.1	.1	40
INDIVIDUAL DISCUSSION							
GROUP DISCUSSION							
READING TEXTS	.8				.1	.1	20
EXPERT DEMONSTRATION/VISUAL AIDS	.5				.7	.3	20
PROGRAMMED INSTRUCTION							
GAMES							
SIMULATION							
HANDS ON PRACTICE — REAL HARDWARE							

TRAINING METHODS WORKSHEET #2

TASK

Enter the percentage of each of the following skills required for the performance of task above.

The performance of all skills must sum to 100.

SKILLS	% REQUIRED FOR PERFORMANCE
KNOWLEDGE	
UNDERSTANDING	
VERBAL/WRITTEN	
PSYCHOMOTOR	
PERCEPTION	
DECISION MAKING	
SUM	

TRAINING METHODS WORKSHEET #2

EXAMPLE

TASK: Detect and identify target

Enter the percentage of each of the following skills required for the performance of task above.

The performance of all skills must sum to 100.

SKILLS	% REQUIRED FOR PERFORMANCE
KNOWLEDGE	40
UNDERSTANDING	
VERBAL/WRITTEN	
PSYCHOMOTOR	
PERCEPTION	40
DECISION MAKING	20
SUM	100

TRAINING METHODS WORKSHEET #5

TASK

TRAINING METHODS	SKILLS: KNOWLEDGE	UNDERSTANDING	VERBAL/WRITTEN	PSYCHOMOTOR	PERCEPTUAL	DECISION MAKING	
ORAL/WRITTEN DRILL/PRACTICE							
LECTURE							
INDIVIDUAL DISCUSSION							
GROUP DISCUSSION							
READING TEXTS							
EXPERT DEMONSTRATION/VISUAL AIDS							
PROGRAMMED INSTRUCTION							
GAMES							
SIMULATION							
HANDS ON PRACTICE — REAL HARDWARE							
SUM OF COLUMN							
% OF TASK INVOLVING SKILL							

CORRELATION COEFFICIENT [ ]

INDEX OF ADEQUACY [ ]

TRAINING METHODS WORKSHEET #3

EXAMPLE

TASK: Detect and Identify target

SKILLS

TRAINING METHODS	KNOWLEDGE	UNDERSTANDING	VERBAL/WRITTEN	PSYCHOMOTOR	PERCEPTUAL	DECISION MAKING
ORAL/WRITTEN DRILL/PRACTICE						
LECTURE	28				4	4
INDIVIDUAL DISCUSSION						
GROUP DISCUSSION						
READING TEXTS	16				2	2
EXPERT DEMONSTRATION/VISUAL AIDS	10				14	6
PROGRAMMED INSTRUCTION						
GAMES						
SIMULATION						
HANDS ON PRACTICE — REAL HARDWARE						
SUM OF COLUMN	54				20	12
% OF TASK INVOLVING SKILLS	40				40	20

CORRELATION COEFFICIENT: .65

INDEX OF ADEQUACY: 65

UTILITY ESTIMATE WORKSHEET

Estimate the utility of each listed Training Method in the matrix below for the training of each skill, according to the current technology. Your Utility ratings should fall between 0 and 1.0. Zero means that this method has absolutely no utility for training this skill. 1.0 means that this method is the best possible for training this skill. The Utility ratings do not have to sum to 1.0 for a given skill.

Return to sender upon completion.

TRAINING METHODS	SKILLS: KNOWLEDGE	UNDERSTANDING	VERBAL/WRITTEN	PSYCHOMOTOR	PERCEPTUAL	DECISION MAKING
ORAL/WRITTEN DRILL/PRACTICE						
LECTURE						
INDIVIDUAL DISCUSSION						
GROUP DISCUSSION						
READING TEXTS						
EXPERT DEMONSTRATION/VISUAL AIDS						
PROGRAMMED INSTRUCTION						
GAMES						
SIMULATION						
HANDS ON PRACTICE – REAL HARDWARE						

TRAINING MEASURE #4
MEASURE OF THE ADEQUACY OF OPERATIONAL TEST TRAINERS

DESCRIPTION: One of the major variables of training which can produce sub-criterion performance of a task is inadequate trainer functioning. Trainers' styles vary considerably. This variation makes it difficult to take meaningful measures of trainer functioning by observation. Two other alternatives remain:

(1) measuring attitudes toward trainer performance (carried out in HRTES questionnaires); and
(2) measuring and evaluating trainer background experiences.

This latter measure is based on the supposition that the level of a trainer's background will have a significant effect on ability to effectively train a task.

In this measure, you develop a list of background experiences which are desirable for training a task that is being analyzed. You, or some other training expert you select, rates each of these background experiences on a utility scale. You also determine, or obtain, estimates of the minimum amount of time required for each of these background experiences. You then determine which of these background experiences the appropriate trainer(s) had and the amount of time for each one. Finally, you compare actual trainer experiences with those which were selected as being desirable for training the task being analyzed.

PROCEDURE:

(1) In the first column of the "Index of Trainer Adequacy Worksheet," list the specific background experiences which a trainer should have to effectively train the task being analyzed. This should include: experiences as a trainer, if any; specific operational or maintenance experiences, if any; specialties held, if any; and educational experiences, if any.

(2) For each background experience listed estimate the <u>minimal</u> amount of time required in the second column of the worksheet. These amounts of time should be listed as months.

(3) Rate each listed background activity on the following scale. Select any number from 0-100. It is understood that since you have already stated that these activities are required, you will <u>never</u> rate any of them "0". The lower anchor of this scale is presented to make its meaning clearer. When you have rated a given background activity record the rating in the third column of the worksheet.

NONE		MODERATE		ABSOLUTELY REQUIRED
0	25	50	75	100
No utility for training this task		Moderately useful for training this task		Absolutely required for training this task

(4) Multiply the time and utility weight of each background experience. Record the resulting product in the fourth column of the worksheet.

(5) Add the products in the fourth column of the worksheet, and record the resulting sum in the Sum (A) box of the worksheet.

(6) Determine if the trainer(s) of the task being diagnosed had each of these background experiences (or others which were functionally identical). If the trainer(s) did not have an experience, determine how many months were devoted to it. If more than one trainer trained the personnel who performed this task inadequately, compute the means of the months of the experiences. If the actual trainer time for any given background experience is greater than the minimum acceptable time (which has been recorded), record the minimum acceptable time. Do not record the actual trainer time. Without this truncation it would be possible for large amounts of experience in one area to entirely obscure a total absence in another. If the actual trainer time is less than the minimum acceptable time, record it directly.

(7) Multiply the utility weight of each background experience (from the second column) by the actual trainer time of that experience (from the fifth column). Record the resulting products in the sixth column of the worksheet.

(8) Add these products, and record the resulting sum in the Sum (B) box on the worksheet.

(9) Divide Sum (B) by Sum (A). Multiply the resulting quotient by 100. Record the resulting product in the Index box of the worksheet. This is the Index of Adequacy of Trainer Background for the task. If the trainer's background is entirely appropriate for training this task, the Index will be approximately 100. The less adequate the background, the further the Index will be below 100.

INDEX OF TRAINER ADEQUACY WORKSHEET

TASK:

BACKGROUND EXPERIENCE	TIME	WEIGHT	PRODUCT	TRAINER TIME	PRODUCT
		SUM (A)		SUM (B)	

SUM (A) ÷ SUM (B) × 100 = INDEX

SUMMARY WORKSHEET FOR TRAINING ANALYSIS

TASK: _____

CONDITIONS (if applicable): _____

ISSUE: _____

SPECIFIC TRAINING PROBLEMS CONTRIBUTING TO INDICES	TRAINING MEASURE INDICES OF ADEQUACY	EXP OR QUEST	TRAINING INDEX OF ADEQUACY
	1 TRAINING TIME ALLOCATION ☐		
	2 PRACTICE CONDITIONS ADEQUACY ☐		TRAINING ☐
	3 TRAINING METHODS ADEQUACY ☐		
	4 OT TRAINER ADEQUACY ☐		

HUMAN FACTORS ENGINEERING (HFE) MEASURES

CONTENTS:

CONTENTS (Continued):

GENERAL INSTRUCTIONS FOR HUMAN FACTORS ENGINEERING (HFE) MEASURES

DESCRIPTION: An operational test (OT) has been completed recently. For the specifics of this OT, see "Task Evaluation Worksheet" of this submission. Various operator and maintainer tasks were measured during this OT. One or more of these tasks was evaluated as having been performed inadequately.

Operational testing and evaluation personnel have determined that those tasks that are listed are of significant importance to the overall evaluation of the system that was tested. They need to know <u>why</u> these tasks were performed inadequately. One possible reason is that the human-machine interface, or the actual procedure itself, was inadequate in some way, and this inadequacy was a cause of the level of performance.

This section includes a set of "General Procedures" that applies to <u>all</u> of the listed HFE measures. Each of the first 8 measures has its own specific procedures that accompanies the measure worksheet. Measures 9-15 have a common set of procedures. These procedures apply to each of these measures. They are listed in this section and are entitled "Common Procedures for Measures 9-15." Measure 16, "Workload" is entirely based on the "Workload Scale" found in the Player and Observer Questionnaires for the task being diagnosed.

Your first problem will be to decide which of these measures to take of each task. During the OT, players and observers filled in questionnaires in which they gave their opinions of the difficulty of each task and the reasons for significant difficulty. If any player or observer thought that performing a given task was difficult and that task is one of those being analyzed now, you will have a Questionnaire for it. In this case, the

scale scores listed may be helpful to you in deciding which HFE measures to take. If a score indicates significant difficulty (50 or below) it is reasonable to take the corresponding HFE measure for that task. It is, of course, possible that players and observers were not able to judge whether there was something which was inadequate and produced inadequate task performance. Therefore, these scores, if they are available, can only be a guide for you to use as you think best.

GENERAL PROCEDURE (APPLIES TO ALL HFE MEASURES):

(1) Examine the Questionnaires for each task. Use their scores as an aid to selecting parallel HFE measures. If you do not have one or more such questionnaires, use your best judgment for deciding which measures to take of each task.

(2) When you have finished taking the measures you have selected for each task, make as many copies of the "Summary Worksheet for the HFE Analysis" as you need for the tasks you have analyzed.

(3) Fill in the information at the top and extreme bottom of each worksheet.

(4) Record the specific HFE indices of adequacy for the measures you have taken for each task being analyzed. This is to be done in the appropriately labeled boxes on the worksheets.

(5) If you have not taken a specific HFE measure for a given task, and if you have Questionnaires for that task, use the appropriate questionnaire scale score as an Index of Adequacy. In the case of "Workload," this will always be the case. Record the questionnaire based score(s) in the appropriate labeled box.

(6) If you have not taken a specific HFE measure for a given task, and if you do not have a questionnaire for that task, record an "X" in the appropriate box.

(7) Next to each specific index of adequacy record an "EXP" or "QUEST" in the third column of the worksheet. "EXP" is recorded next to an Index which was based on an expert measure you have taken. "QUEST" is recorded next to an index which was based on a questionnaire scale for that HPF.

(8) Record the specific HFE problem(s) that caused any specific index of adequacy to be significantly below 100. This is to be done in the first column of the worksheet. If necessary, append an addition sheet for this explanatory purpose, and reference it in the first column.

(9) Compute the means of the specific indices of adequacy according to the branching structure on the worksheet. Means are to be computed of Indices: 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 12 + 13 + 14 + 15. Measure 16, Workload, is simply transferred to the next box. If you have recorded an "X" in any box, leave it out of the computation. Record the resulting means in the appropriate boxes for Collective Indices.

(10) If all of the specific indices are absent, for a given collective index, record an "X" in the box for that collective index.

(11) Compute the mean of the collective indices. If you have recorded an "X" in any collective index box, leave it out of the computation. Record the mean in the Human Factors Engineering Box at the extreme right of the worksheet.

(12) When you have completed the HFE measures and the "Summary Worksheet for HFE Analysis" return all materials to the sender.

COMMON PROCEDURES FOR MEASURES 9 THROUGH 14:

(1) Study the characteristics listed on the worksheet. If you think that a significant characteristic is missing, add it in the "Other" category.

(2) Decide if each characteristic on the worksheet is relevant to the performance of the task being analyzed in this system. If it might have a significant effect on task performance in this system, it is relevant. In this case, record an "X" in the appropriate cell of the Relevance Column. If a characteristic is not relevant, record a "0" in the cell.

(3) Rate each characteristic that you have selected on the criticality scale which follows. Select any rating from 1-100. Record the ratings in the appropriate cells of the Rating Column.

LOW CRITICALITY	MODERATE CRITICALITY	HIGH CRITICALITY
1 25	50 75	100
Just important enough to be measured. Criticality low for this task.	Criticality moderate for this task.	Criticality extremely high for this task.

(4) Obtain appropriate measurements of each characteristic you have selected. This may be done in the following ways:

(a) Obtaining appropriate measurements from previous OT's, DT's, HFE tests, or other reasonably reliable sources.
(b) Physically taking the necessary measurements from the actual system.
(c) Taking some version of the necessary measurements from system documentation.

(5) Compare each measurement with the standard or specification which applies to it. This may be done in the following ways:

(a) Comparison with reasonably valid specifications such as those found in MIL STD-1472, HEDGE, and HFTEMAN--this is, of course, preferable.
(b) Evaluation based on expert judgment--in the absence of an applicable standard, your judgment may be substituted.

(6) If a given characteristic meets its standard, record a "1" in the appropriate cell of the 0/1 column. If it does not meet its standard (or your judgment), record a "0" in this cell.

(7) Record the source of each comparison in the appropriate cell of the Source Column. This should be information as to the source of the measurement itself and the standard. If there is insufficient space to record all the required source information, append a page and use the space to refer to it.

(8) Multiply the 0 or 1 for each characteristic by the 1-100 rating of its criticality. Record the resulting products in the appropriate cells of the Product Column.

(9) Add all the products, and record the resulting sum in the Product Sum Cell.

(10) Add all the 0 or 1 ratings in the Rating Column, and record the resulting sum in the Rating Sum Cell.

(11) Divide the Product Sum by the Rating Sum, and multiply the resulting quotient by 100. Record the resulting product in the Index Cell. This is the Index of Adequacy for this measure. If the measures of the significant characteristics just met their standards, the Index would be approximately 100. The less adequate the characteristics that are measured, considering their criticality, the farther below 100 will be the Index.

HFE MEASURE #1

UNDERSTANDABILITY OF PROCEDURE

DESCRIPTION: When a task has been performed inadequately, one possible cause is that its procedure was too difficult for the performers. This measure requires an analysis of the performance of the task being analyzed into its component performance elements. These elements are then used as the basis for a multi-attribute rating process. Therefore, to use this measure, one must either fully understand the procedure for this task, or have access to an individual who understands it and will decompose the procedure into its elements for you.

PROCEDURE:

(1) On Worksheet #1, list the elements required to perform the task being analyzed. These elements should be analyzed to the smallest level of detail possible. This analysis should be made for the specific system tested in the OT.

(2) On Worksheet #1, specify the sequence of performance of the listed elements. This is done by recording sequence numbers in the appropriate Performance Sequence Cells of the worksheet (first element performed is numbered 1, etc.). In general, these sequence numbers should be recorded in the left-hand column under the heading, "Performance Sequence." However, sometimes an element may be performed more than once during a task. In this case, record the second sequence number for that element in the next column, the third number for that element in the third column, etc. If two elements are performed at the same time, give them the same sequence number.

(3) When you have finished recording the elements and their sequence numbers, add the total number of elements. Record the sum in the box at the bottom of the worksheet.

(4) On Worksheet #2, rate the task that you have analyzed. Use all three scales, and assign any rating from 0-100 to each. Record the three ratings in the appropriate boxes of this worksheet. Two of the three scales are based on the material you developed in Worksheet #1.

(5) Compute the mean of the three rating scales, and record it in the Mean Box at the top of Worksheet #2.

PROCEDURE UNDERSTANDABILITY

WORKSHEET #1

TASK: _____

ELEMENTS REQUIRED FOR TASK PERFORMANCE	PERFORMANCE SEQUENCE				

TOTAL NUMBER OF REQUIRED ELEMENTS: [ ]

PROCEDURE UNDERSTANDABILITY
WORKSHEET #2

TASK: _____

Assign a rating of 0-100 to each of the following attributes of understanding of procedures for the task listed above.

MEAN RATING (INDEX) = ☐

1. What is the degree of similarity between the procedure for performing this task and the procedure for a similar task that the OT players have actually performed, previously?

☐

0 — 25 — 50 — 75 — 100

Totally unrelated to any previous procedure.	Moderately related to a previously performed procedure.	100% identical to previous procedure.

2. What is the effect of this task's number of elements (shown on the proceeding worksheet) on the difficulty of understanding the procedure?

☐

0 — 25 — 50 — 75 — 100

Number so large, it makes understanding impossibly difficult.	Number of elements produces moderate difficulty in understanding procedure.	This number of elements would not increase the understanding difficulty at all.

3. What is the effect of the complexity of the sequence of performance of the task elements (shown on the preceding worksheet) on the difficulty of understanding the performance?

☐

0 — 25 — 50 — 75 — 100

Sequence so complex, understanding of performance is impossible.	Sequence complexity produces moderate difficulty in understanding procedure.	Sequence so simple and linear would not increase understanding difficulty at all.

HFE MEASURE #2
DIFFICULTY OF DECISIONS

DESCRIPTION: One possible cause of inadequate task performance is that the required decisions were too difficult for the performers. This measure requires an analysis of the task being analyzed into its decisions and those decisions into their alternative responses. These decidions and responses are then used as a basis for a multi-attribute ranging process. Therefore, to use this measure one must either fully understand the task in the system that was tested, or have access to an individual who does.

PROCEDURE:

(1) On Worksheet #1, list all the decisions which must be made to perform this task in this system. Then list them on Worksheet #2.

(2) On Worksheet #1, for each listed decision, record the realistic alternative responses. These are the actual outcomes among which the individual making the decision must choose.

(3) On Worksheet #1, for each decision, add the total number of alternative responses, and record the resulting sums.

(4) On Worksheet #1, add the total number of decisions required for the performance of the task, and record the resulting sum in the box at the top of the first page of the worksheet.

(5) On Worksheet #2, apply "Rating Scales for Decision Difficulty Worksheet #2" to the material you have developed on Worksheet #1. The first scale of the Rating Scales applies to all

decisions required for the task taken <u>together</u>. Record your rating for this first scale in the Rating for Scale One box at the top of Worksheet #2. All other rating scales apply to <u>each</u> decision listed on Worksheet #2. So, apply each rating scale (from 2-4) to each listed decision, and record the resulting ratings in the appropriate cells of Worksheet #2.

(6) On Worksheet #2, <u>for each decision</u>, add the ratings of all scales <u>plus</u> the rating of scale one (scale one rating is located in the box at the top of the worksheet). Record the resulting sums in the appropriate cells of the left-hand column of the worksheet.

(7) Add all the sums in the left-hand column of Worksheet #2. Divide this grand sum by the total number of decisions (from Worksheet #1) multiplied by six (the number of rating scales). Record this mean rating in the appropriate box at the bottom of worksheet #2.

(8) For clarity, the rating scales of this measure were designed so that the higher the rating the greater the difficulty. To make the Index of Adequacy comparable to other Indices, this direction must be reversed. Therefore, the final step in this computation is to subtract the product computed in step 7 from 100. Record the resulting number in the Index Box on the bottom of Worksheet #2. If this Index of Adequacy is approximately 100, decision difficulty for the task is entirely adequate. The farther below 100 in this Index, the less adequate is decision difficulty.

DECISION DIFFICULTY RATING
WORKSHEET #1

TASK: _____

First, list all the types of decisions that must be made to perform the task above in this system. Second, for each type of decision listed, specify alternative responses among which each decision selects. Third, record the total number of decisions required for this task and the number of alternative responses for each decision. Fourth, complete the rating scales, on the attached worksheet, which apply to the information you have just developed. If there is insufficient space on this worksheet, photocopy it.

TOTAL NUMBER OF DECISIONS REQUIRED FOR TASK [ ]

DECISIONS REQUIRED FOR TASK	ALTERNATIVE RESPONSES TO EACH DECISION
	SUM =
	SUM =
	SUM =

DECISION DIFFICULTY RATING
WORKSHEET #1 (CONTINUED)

DECISIONS REQUIRED FOR TASK	ALTERNATIVE RESPONSES TO EACH DECISION
	SUM =
	SUM =
	SUM =
	SUM =
	SUM =

DECISION DIFFICULTY RATING
WORKSHEET #1 (CONTINUED)

DECISIONS REQUIRED FOR TASK	ALTERNATIVE RESPONSES TO EACH DECISION
	SUM =
	SUM =
	SUM =
	SUM =
	SUM =

RATING SCALES FOR DECISION
DIFFICULTY WORKSHEET #2

HPF: _____

Rating scale number one applies to all decisions required for this task, taken together. All other rating scales apply to each required decision, independently. Record your rating from the rating scale number one in the box at the top of Worksheet #2, and all other ratings in the appropriate cells of the worksheet.

1. How difficult would it be to make the number of decisions required for the performance of this task in this system?

0	25	50	75	100
No difficulty at all.		Moderately difficult.		So difficult that it could not be done.

2. How significant would this decision be when made as part of the task in this system?

0	25	50	75	100
No significance at all.		Moderately significant.		Extremely significant. Affects mission success, system survivability.

3. Under realistic conditions, how much time will be likely to be available to make this decision and still permit the task to be performed successfully?

0	25	50	75	100
Time is not an issue at all. Any amount can be taken.		Moderate amount of time can be taken and the task can be performed successfully.		Only a very small amount of time can be taken.

RATING SCALES
WORKSHEET #2 (CONTINUED)

4. To what extent is this decision *irreversible* if made during the performance of this HPF in this system?

0	25	50	75	100
Not an issue. Decision may be reversed as many times as desired.		Small number of reversals possible.		Irreversibility total. Decision must stand as made.

5. How difficult would it be to make this decision considering the *number of alternative responses* possible?

0	25	50	75	100
No difficulty at all.		Moderately difficult.		So difficult that this decision could not be made successfully.

6. How *similar are the alternative responses* which must be considered in making this decision?

0	25	50	75	100
No similarity at all. Responses are completely different from each other.		Moderately similar.		Responses are extremely similar. Hard to separate.

DECISION DIFFICULTY WORKSHEET #2

TASK: _____

RATING FOR SCALE ONE: ☐

	SIGNIFICANCE	TIME	IRREVERSIBILITY	NUMBER OF ALTERNATIVES	ALTERNATIVE SIMILARITY	SUM + SCALE ONE RATING

GRAND SUM: ☐

$$\frac{\text{GRAND SUM}}{\text{TOTAL \# OF DECISIONS X 6}} = \frac{100}{\square} = \square \text{ INDEX OF ADEQUACY}$$

HFE MEASURE #3
ADEQUACY AND TIMELINESS OF DISPLAY INFORMATION

DESCRIPTION: One possible cause of inadequate task performance is that required information was not available in time for its use. This measure requires the identification of the information required for the performance of the task being diagnosed. In addition, it requires the judgment of whether each piece of required information is time sensitive. If a piece of information is so judged, it then requires the judgment of the maximum length of time that can occur before the useful appearance of that information. Therefore, to use this measure, one must thoroughly understand the information requirements for the task, have access to detailed documentation about these requirements, or have access to an individual who thoroughly understands these requirements.

PROCEDURE:

(1) Record all the information which is absolutely required for the successful performance of the task being diagnosed. This includes information that would be produced visually or auditorily. It does not apply to one display only. It applies to all the displays that produce such required information.

(2) Next, determine if each piece of listed information is time sensitive and if the display that produces that information could be a significant factor when the information was presented. For example, target range may be a piece of information that is absolutely required. Further, it is likely to be time sensitive. However, if it is produced by

a radio, the radio cannot affect presentation time (except by malfunctioning). In this case, target range produced by radio would not meet the time sensitivity criteria.

(3) For each recorded information requirement that meets both of these criteria, record an "X" in the appropriate cell of the X Column.

(4) For each information requirement with an adjacent "X" estimate the maximum length of time permissible between some fixed point in time and the appearance of that information. Frequently, the fixed point in time will be the start of the task. However, it really depends upon the data available.

(5) Record each permissible time in the appropriate cell of the Time Column. It may be impossible to make certain time estimates. If this cannot be done, replace its "X" with an "*".

(6) Compare the information requirements listed on the worksheet with the information actually produced by the display(s) used in task performance. This may be done with the actual physical equipment, or detailed specifications of that equipment.

(7) If a given piece of required information is actually produced, record a "1" in the appropriate cell of the 1/0 column. If it is not produced, record a "0".

(8) For each piece of information that has both a "1" (from step 7) and an "X" (meaning it is time sensitive), determine the length of time between the fixed start time (see step 4) and

the appearance of that information. If you are unable to obtain this time data, record an asterisk ("*") in the appropriate cell of the 1/0 TIME Column.

(9) If a piece of required information appears on or before the listed time limit, record a "1" in the appropriate cell of the 1/0 TIME Column. If it does not, record a "0".

(10) For each listed piece of required information, multiply the contents of its 1/0 and 1/0 TIME Cells. An 1/0 Cell can contain a "0" or a "1". An 1/0 TIME Cell can contain a "0", a "1", an asterisk "*", or nothing. Clearly, you only multiply zeroes and ones. For each piece of information, record the product of multiplying the zeroes and ones in the appropriate cell of the PRDCT Column. If an 1/0 TIME Cell has an asterisk or nothing as its content, record the content of the parallel 1/0 Cell in the PRDCT Column.

(11) Add the contents of the PRDCT Column, and record the resulting sum in the Sum box at the bottom of the worksheet.

(12) Count the number of pieces of required information for the task. Divide the number in the Sum box (from step 1) by the total number of pieces of required information. Record the resulting quotient at the bottom of the worksheet.

(13) Multiply the quotient by 100, and record the resulting product in the Index box at the bottom of the worksheet. This is the Index of Adequacy of this measure. If it is approximately 100, all required information is present and has been presented soon enough to be useful. The further below 100 this Index, the less adequate and timely the information presented.

DISPLAY INFORMATION ADEQUACY
AND TIMELINESS WORKSHEET

TASK: _____

INFORMATION THAT IS ABSOLUTELY REQUIRED	X	1/O	TIME	1/O TIME	PRDCTS
				SUM =	

SUM/# PIECES OF INFORMATION = [ ] X 100 = [ ] INDEX

HFE MEASURE #4
DISPLAY READABILITY/HEARABILITY

DESCRIPTION: HFE Measure #4 (Adequacy and Timeliness of Display Information) results in a list of pieces of information that are both absolutely required for task performance and presented by system display(s) in time to be used. Other information that is not absolutely required and that is also presented by displays may have some utility for task performance. However, such information is, by definition, not required for this performance. Therefore, the only significant reason for studying this non-required information is to determine the "clutter" and overload produced by the display(s).

Even if required information is presented (and presented in time for use), the nature of its presentation may vary in adequacy. If such information is presented, but in an entirely inadequate matter, it may be unusable. The nature of presentation is, therefore, a possible cause of inadequate task performance.

This measure is based on the list of information developed in HFE Measure #3. It includes three worksheets. Worksheet #1 provides a format for assigning required pieces of information (from HFE Measure #3) to their originating displays. This is necessary since these pieces of information are measured independent of their displays in Measure #3. Worksheet #2 provides the format for measuring visual displays. Worksheet #3 provides the format for measuring auditory displays. In both Worksheets #2 and #2, the formats of required information provided by a single display are rated, measured, and compared to standards.

PROCEDURE:

(1) On Worksheet #1 list all the visual and auditory displays that produce required information for the task being analyzed. Also record the required information. This information should be available from the completed Measure #3.

(2) Record "X's" in the appropriate cells of Worksheet #1 to indicate the display(s) that produce each piece of required information. The remainder of this procedure applies to any single task being diagnosed.

(3) Examine your completed Worksheet #1, and determine how many visual displays are listed. Make as many copies of Worksheet #2 as you need for measuring visual displays (one worksheet per display). Do the same for auditory displays (copying Worksheet #3).

(4) Fill in the background information on each Worksheet.

(5) For each Worksheet #2 and #2, apply the "Common Procedures for Measures 9 through 14."

(6) If more than one display were rated in this Measure, compute the mean of the various Indices of Adequacy which resulted, and record this Mean Index in the appropriate box of Worksheet #1.

DISPLAY READABILITY/HEARABILITY
WORKSHEET #2 (VISUAL)

TASK: _____

CONDITIONS (if applicable): _____

IF MORE THAN ONE DISPLAY IS USED FOR THIS TASK RECORD MEAN INDEX OF ALL DISPLAYS IN BOX WHICH FOLLOWS (COMPUTED FROM WORKSHEETS #1 AND/OR #2):

MEAN READABILITY/HEARABILITY INDEX FOR TASK ☐

REQUIRED INFORMATION FOR TASK	VISUAL AND AUDITORY DISPLAYS							

DISPLAY READABILITY/UNDERSTANDABILITY
WORKSHEET #2 (AUDITORY)

DISPLAY: _____

TASK: _____

CONDITIONS: _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
VOLUME					
FREQUENCY RANGE					
DYNAMIC RANGE					
SIGNAL TO NOISE RATIO					
HARMONIC DISTORTION					
CLIPPING					
DISCRIMINABILITY					
ALERTING CAPABILITY					
MASKING					
SPURIOUS SIGNALS					
OTHER:					
		RATING SUM:		PRDCT SUM	INDEX:

DISPLAY READABILITY/HEARABILITY
WORKSHEET #3 (AUDITORY)

DISPLAY: _____

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	O/I	PROCT	SOURCE
SIZE OF SYMBOL(S)					
SHAPE/STYLE OF SYMBOL(S)					
DEFINITION					
BRIGHTNESS					
FIGURE-GROUND CONTRAST					
COLOR					
PLACEMENT OF SYMBOL(S)					
MOTION (in relation to realworld motion)					
RESOLUTION					
JITTER					
GREY SCALE GRADATION					
FLICKER FREQUENCY					
SIGNAL TO NOISE RATIO					
REFLECTIVITY					
SIZE OF DISPLAY					
VIEWING ANGLE					
VIEWING DISTANCE					
PLACEMENT					
FUNCTIONAL CLUSTERING					
OTHER:					
RATING SUM:					INDEX:
			PROCT		

HFE MEASURE #5
DISPLAY INFORMATION UNDERSTANDABILITY

DESCRIPTION: The purpose of this measure is to determine the adequacy of a display(s) presentation that leads to the understanding of information. This is in some contrast to HFE Measure #4 that deals with display presentation that leads to perception of required information. Apart from this distinction, this HFE Measure is basically quite similar to Measure #4. It can be used without direct reference to the specific pieces of information that are required for task performance. However, it should result in more valid and reliable findings if it is based on a completed "Display Visibility/Hearability Worksheet #1" from HFE Measure #4. In this measure, you rate display understandability on a multi-attribute scale, specific to each task being analyzed.

PROCEDURE:

(1) If you have completed HFE Measure #4, retrieve the filled in "Display Visibility/Hearability Worksheet #1."

(2) Record the names of the appropriate displays, used in task performance.

(3) Rate the understandability of the presentation of the required information for each display on the six scales found in "Rating Scales for Display Information Understandability Worksheet."

(4) Add all ratings for each display, and record the resulting sums in the appropriate cells of the Sum column.

(5) Divide each sum (from Step 6) by four--the number of scales used. Record the resulting quotients in the appropriate cells of the Sum/6 Column. These are the Indices of Adequacy for each display used in the task. If a given display was completely inadequate, its Index should be approximately 100. The less adequate the display, the further below 100 will be the Index.

(6) If a task used only one display, the measure will now be complete. If the task used more than one display, compute the mean of the Indices (from Step 5). Record this Mean Index in the appropriate box at the bottom of the worksheet.

RATING SCALES FOR DISPLAY INFORMATION

UNDERSTANDABILITY WORKSHEET

1. How adequate is the level of simplicity (as opposed to complexity) of the vocabulary and/or symbols used by this display to impart information for this task?

COMPLETELY INADEQUATE				COMPLETELY ADEQUATE
0	25	50	75	100
So complex they will be impossible to understand.		May cause some problems.		Should cause no difficulty.

2. How familiar is the vocabulary and/or symbology used in this display for this task likely to be to the user population?

COMPLETELY UNFAMILIAR				COMPLETELY FAMILIAR
0	25	50	75	100
No transfer of training possible.		Some transfer possible.		Sufficient transfer of training should take place.

3. To what extent are the symbols/vocabulary used in the display for the task similar to other symbols/vocabulary that have a different meaning?

COMPLETELY CONFUSING				COMPLETELY CLEAR
0	25	50	75	100
Identical to other symbols/vocabulary, but with a radically different meaning.		Moderate confusion between this symbology/ vocabulary and meaning of similar one.		Symbols/vocabulary either adequately different from other, or with adequately similar meaning.

.4. How adequate is the total amount of information presented, at any given time by this display, for the understanding of that information for this task?

COMPLETELY INADEQUATE			COMPLETELY ADEQUATE
0 — 25	50	75 —	100
So much information presented at once that it cannot be understood, or so little that the key relationships are lost.	Moderately understanable amount of information presented at one time.		Understandable amount of information presented at one time for understanding.

5. How adequate is the amount of time in which required information is presented by this display for this task, for the understanding of that information?

COMPLETELY INADEQUATE			COMPLETELY ADEQUATE
0 — 25	50	75 —	100
Presentation time totally much too short.	Presentation time a little too short.		Adequate amount of presentation time.

6. How adequate was the rate of presentation of information by this display, for this task, for the understanding of that information?

COMPLETELY INADEQUATE			COMPLETELY ADEQUATE
0 — 25	50	75 —	100
Presentation rate much to rapid.	Moderately inadequate presentation rate.		Presentation rate completely adequate.

DISPLAY INFORMATION

UNDERSTANDABILITY WORKSHEET

TASK: _____

DISPLAYS	LEVEL OF SIMPLICITY	UNFAMILIARITY	SIMILARITY + DIFFERENT MEANING	TOTAL AMOUNT OF INFORMATION	AMOUNT OF TIME PRESENTED	RATE OF PRESENTATION	SUM	SUM/6 (DISPLAY INDICES)

SUM =	
# OF DISPLAYS =	
MEAN INDEX =	

HFE MEASURE #6
CONTROL ACCESSIBILITY

DESCRIPTION: If the performance of a task requires the manipulation of a control (or some other piece of equipment), the adequacy of its accessibility may affect that performance. The harder it is to access a piece of equipment that must be manipulated, the greater the likelihood that the manipulation may be ineffective. The first problem in the measure is to identify those controls and other pieces of equipment that must be manipulated for the adequate performance of the task being analyzed. The second problem is to determine whether each control, or other piece of manipulated equipment, is adequately accessible to its user. Therefore, to take this measure you must have access to the actual hardware, detailed specifications of that hardware, or similar HFE test results from an earlier test.

PROCEDURE:

(1) "Accessibility Adequacy on the Worksheet," list all the controls and other equipment that must be manipulated for adequate performance of the task being analyzed. They should be listed at the most detailed level possible (for example, remove screws A and B, and then remove component C).

(2) If possible, after listing the control/equipment list the title of the crew member who is supposed to perform the manipulation and the hand or foot with which the manipulation should be done.

(3) Either take appropriate accessibility measurements for each control/equipment listed, or take measurements from detailed

specifications or previous tests. In this measure, accessibility is determined by:

(a) Reach distance;
(b) Diameter/circumference of restricted reach envelope;
(c) Reach angle to work location of appropriate individual;
(d) Absence or presence of potentially obscuring object(s) or people.

(4) Compare each measure with its appropriate standard (from MIL-STD-1472, HEDGE, HFTEMAN, etc.). In the absence of such objective standards, you may substitute your expert judgment, though this is substantially less desirable.

(5) If a given control/equipment meets all accessibility standards (or your judgment) record a "1" in the appropriate cell of the 0/1 column on the worksheet. If it does not meet all such standards, record a "0".

(6) Record the source of your standard and measurement in the appropriate cell of the Source column. If there is insufficient space in a cell, record the source information on an appended sheet, and reference it in the cell.

(7) If a given control/equipment is given a "0", it is suggested that you append a sheet, and describe the nature of the accessibility problem in some detail on this sheet.

(8) Add the contents of the cells of the 0/1 column, and record the resulting sum in the Sum box.

(9) Count the number of controls and pieces of equipment to be manipulated for the task. Record this number in the # Controls/Equipment box.

(10) Divide the sum by the number of controls/equipment, and multiply the resulting quotient by 100. Record this product in the Index box. This is the Index of Adequacy of Accessibility. If all controls and other equipment to be manipulated are fully accessible, this Index will be approximately 100. The less adequate their accessibility, the further below 100 will be the Index.

ACCESSIBILITY ADEQUACY WORKSHEET

TASK: _____

CONDITIONS: _____

CONTROLS/EQUIPMENT; JOB TITLE; HAND/FOOT	0/1	SOURCE

CONTROLS/EQUIP [ ] SUM [ ]

INDEX [ ]

HFE MEASURE #7
CONTROL STATIC CHARACTERISTICS

DESCRIPTION: In HERTES static characteristics, dynamic characteristics, and accessibility have been separated into categories of measures of control and other equipment to be manipulated. Static characteristics are those that affect: location, identification, and individual activation of controls or other equipment to be manipulated in the performance of a task that is being analyzed. When a task has been performed inadequately, one possible cause is that the control(s) or other equipment which had to be manipulated could not be: identified in time by touch or vision; or activated independently of adjacent controls. This measure uses the "Accessibility Worksheet" from HFE Measure #6. On this previous worksheet you identified those controls and other equipment to be manipulated for the task. These same controls/equipment will now have their static characteristics measured and compared to objective or subjective standards. The steps of this measure are largely identical to those described in Common Procedures.

PROCEDURE:

(1) Retrieve your completed copy of "Accessibility Adequacy Worksheet" from HFE Measure #6, and copy the controls and other equipment to be manipulated. If Measure #6 has not been completed, you will have to develop this list now. It consists of those controls and other pieces of equipment to be manipulated in the performance of the task that are absolutely necessary.

(2) Study the characteristics listed on the worksheet. If you think that a significant characteristic is missing, add it in the "Other" category.

(3) For each control/equipment listed decide if each characteristic on the worksheet is relevant to the performance of the task being diagnosed in this system. If it might have a significant effect on the task performance in this system, it is relevant. In this case record an "X" in the appropriate cell of the Relevance row. If a characteristic is not relevant, record a "0" in the cell.

(4) Rate each characteristic that you have selected for each control/equipment on the criticality scale which follows. Select any rating from 1-100. Record the ratings in the appropriate cells of the Rating row.

LOW CRITICALITY	MODERATE CRITICALITY	HIGH CRITICALITY
1 25	50 75	100
Just important enough to be measured. Criticality low for this task.	Criticality moderate for this task.	Criticality extremely high for this task.

(5) Obtain appropriate measurements of each characteristic you have selected. This may be done in the following ways:

(a) Obtaining appropriate measurements from previous OT's DT's, HFE tests, or other reasonably reliable sources;
(b) Physically taking the necessary measurements from the actual system;
(c) Taking some version of the necessary measurements from system documentation.

(6) Compare each measurement with the standard or specification which applies to it. This may be done in the following ways:

(a) Comparison with reasonably valid specifications such as those found in MIL STD-1472, HEDGE, and HFTEMAN--this is, of course, preferable;

(b) Evaluation based on expert jedgment--in the absence of an applicable standard your judgment may be substituted.

(7) If a given characteristic meets its standard, record a "1" in the appropriate cell of the 0/1 row. If it does not meet its standard (or your judgment), record a "0" in this cell.

(8) Record the source of each comparison in the appropriate cell of the Source row. This should be information as to the source of the measurement itself and the standard. If there is insufficient space to record all the required source information, append a page and use the space to refer to it.

(9) Multiply the 0 or 1 for each characteristic by the 1-100 rating of its criticality. Record the resulting products in the appropriate cells of the Product row.

(10) Add all the products, and record the resulting sum in the Product Sum Cells.

(11) Add all the 0 or 1 ratings in the Rating column, and record the resulting sum in the Rating Sum Cells.

(12) Divide each Product Sum by its Rating Sum, and multiply the resulting quotient by 100. Record the resulting products in the Control Index Cells. These are the Indices of Adequacy for this measure of controls/equipment. If the measures of

the significant characteristics just met their standards, a given Index would be approximately 100. The less adequate the characteristics that are measured, considering their criticality, the further below 100 will be the Index.

(13) Compute the mean of the Control Indices. Record it in the Mean Index box of the worksheet. This is the Index of Adequacy static characteristics of all controls and equipment to be manipulated in the performance of the task being analyzed.

STATIC CHARACTERISTICS WORKSHEET

TASK: ____

CONDITIONS (if applicable): ______________________________

CONTROLS AND OTHER EQUIPMENT TO BE MANIPULATED FOR HARDWARE	CHARACTERISTICS	SIZE	SHAPE	COLOR/LABELING	FUNCTIONAL PLACEMENT	ORDER	SEPARATION	VISABILITY	OTHER:	SUMS: PRDCT RATING	STATIC CONTROL INDICES
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	RELEVANCE										
	RATING										
	0/1										
	PRDCT										
	SOURCE										

MEAN INDEX ☐

HFE MEASURE #8
CONTROL DYNAMIC CHARACTERISTICS

DESCRIPTION: In HRTES static characteristics, dynamic characteristics, and accessibility have been separated into categories of measures of controls and other equipment to be manipulated. Dynamic characteristics are those that affect control movement and sensing of that movement. This measure uses either the "Accessibility Adequacy Worksheet" from HFE Measure #6, or the "Static Characteristics Worksheet" from HFE Measure #7. On these previous Worksheets you identified those controls and other equipment to be manipulated for the task. These same controls/equipment will now have their dynamic characteristics measured and compared to objective or subjective standards. The steps of this measure are identical to those in HFE Measure #7 and similar to those described in Common Procedures.

PROCEDURE:

(1) Retrieve your completed copy of "Accessibility Adequacy Worksheet" from HFE Measure #6, or "Static Characteristics Worksheet" from HFE Measure #7. Copy the controls and other equipment to be manipulated. If Measures #6 or #7 have not been completed, you will have to develop this list now. It consists of those controls and other pieces of equipment to be manipulated in the performance of the task that are absolutely necessary.

(2) Study the characteristics listed on the Worksheet. If you think that a significant characteristic is missing, add it in the "Other" category.

(3) For each control/equipment listed decide if each characteristic on the Worksheet is relevant to the performance of the task being analyzed in this system. If it might have a significant effect on task performance in this system, it is relevant. In this case record an "X" in the appropriate cell of the Relevance Row. If a characteristic is not relevant, record a "0" in the cell.

(4) Rate each characteristic that you have selected for each control/equipment on the criticality scale which follows. Select any rating from 1-100. Record the ratings in the appropriate cells of the Rating Row.

LOW CRITICALITY	MODERATE CRITICALITY	HIGH CRITICALITY
1 25	50 75	100
Just important enough to be measured. Criticality low for this task.	Criticality moderate for this task.	Criticality extremely high for this task.

(5) Obtain appropriate measurements of each characteristic you have selected. This may be done in the following ways:

(a) Obtaining appropriate measurements from previous OT's DT's, HFE tests, or other reasonably reliable sources.
(b) Physically taking the necessary measurements from the actual system.
(c) Taking some version of the necessary measurements from system documentation.

(6) Compare each measurement with the standard or specification which applies to it. This may be done in the following ways:

(a) Comparison with reasonably valid specifications such as those found in MIL STD-1472, HEDGE, and HFTEMAN--this is, of course, preferable.

(b) Evaluation based on expert judgment--in the absence of an applicable standard your judgment may be substituted.

(7) If a given characteristic meets its standard, record a "1" in the appropriate cell of the 0/1 Row. If it does not meet its standard (or your judgment), record a "0" in its cell.

(8) Record the source of each comparison in the appropriate cell of the Source Row. This should be information as to the source of the measurement itself and the standard. If there is insufficient space to record all the required source information, append a page and use the space to refer to it.

(9) Multiply the 0 or 1 for each characteristic by the 1-100 rating of its criticality. Record the resulting products in the appropriate cells of the Product Row.

(10) Add all the products, and record the resulting sum in the Product Sum Cells.

(11) Add all the 0 or 1 ratings in the Rating Column, and record the resulting sum in the Rating Sum Cells.

(12) Divide each Product Sum <u>by</u> its Rating Sum, and multiply the resulting quotient by 100. Record the resulting products in the Control Index Cells. These are the Indices of Adequacy for this measur of controls/equipment. If the measures of the significant characteristics just met their standards, a giver Index would be approximately 100. The

less adequate the characteristics that are measured, considering their criticality, the further below 100 will be the Index.

(13) Compute the mean of the control Indices. Record it in the Mean Index Box of the Worksheet. This is the Index of Adequacy of Dynamic Characteristics of all controls and equipment to be manipulated in the performance of the task being analyzed.

DYNAMIC CHARACTERISTICS WORKSHEET

TASK: ______________________________

CONDITIONS (if applicable): ______________________________

CONTROLS AND OTHER EQUIPMENT TO BE MANIPULATED FOR HARDWARE	CHARACTERISTICS	RESISTANCE	DIRECTION OF MOTION	FEEDBACK	CONTROL-DISPLAY RATIO	CONTROL-SYSTEM MOTION RATIO	SYSTEM LAG	CONTROL GRADATION LINEARITY	CONTROL GRADATION SIZE	CONTROL JITTER/ VIBRATION	OTHER:	PRDCT SUM: RATING	DYNAMIC CONTROL INDICES
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
	RELEVANCE RATING												
	0/1												
	PRDCT												
SOURCE													

MEAN INDEX ☐

HFE MEASURE #9 - WORKSTATION DIMENSIONAL CHARACTERISTICS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
WORK SURFACE DEPTH					
WORK SURFACE HEIGHT SITTING					
WORK SURFACE HEIGHT STANDING					
WORK SURFACE HEIGHT KNEELING					
WORK SURFACE WIDTH					
WORK SURFACE AREA					
WORK SURFACE SLOPE (ANGLE)					
WORKSPACE DEPTH					
WORKSPACE HEIGHT SITTING					
WORKSPACE HEIGHT STANDING					
WORKSPACE HEIGHT KNEELING					
WORKSPACE UNUSUAL POSITION CLEARANCE					
WORKSPACE LATERAL AREA					
WORKSPACE VOLUME					
FREE FLOOR SPACE					
DOOR/HATCH HEIGHT					
DOOR/HATCH WIDTH					
TREAD DEPTH					
RISER HEIGHT					
RISER WIDTH					
OTHER:					
RATING SUM:					INDEX:
			PRDCT SUM		

HFE MEASURE #10 - WORKSTATION SEATING CHARACTERISTICS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
HEAD CLEARANCE SITTING-VERTICAL					
HEAD CLEARANCE SITTING-LATERAL					
SHOULDER CLEARANCE-VERTICAL					
SHOULDER CLEARANCE-LATERAL					
KNEE CLEARANCE-VERTICAL					
KNEE CLEARANCE-LATERAL					
THIGH CLEARANCE-VERTICAL					
THIGH CLEARANCE-LATERAL					
HIP CLEARANCE-LATERAL					
KICK SPACE					
FOOT SUPPORT LENGTH					
FOOT SUPPORT WIDTH					
FOOT SUPPORT SLOPE (ANGLE)					
FOOT SUPPORT TO SEAT SURFACE					
SEAT SURFACE TO ARM SUPPORT					
ARM SUPPORT LENGTH					
ARM SUPPORT WIDTH					
ARM SUPPORT SLOPE (ANGLE)					
SEAT LENGTH					
SEAT WIDTH-HIP					
SEAT WIDTH-THIGH					
SEAT SLOPE-ANGLE					
SEAT SURFACE HEIGHT					
SEAT BACK LENGTH					
SEAT BACK WIDTH-SHOULDER					
SEAT/BACK SLOPE (ANGLE)					
SEAT MOTION CAPABILITY					
SEAT/BACK CONFORMANCE TO BODY					
SEAT/BACK SHOCK ABSORPTION					
OTHER:					
RATING SUM:					INDEX:
			PRDCT SUM		

HFE MEASURE #11 - WORKSTATION ENVIRONMENT
VISUAL CHARACTERISTICS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

VISUAL CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
EXTERNAL ILLUMINATION					
EXTERNAL WARNING ILLUMINATION					
WORKSTATION AMBIENT ILLUMINATION					
WORKSTATION DIRECT ILLUMINATION					
EXTERNAL FIELD OF VIEW					
VIEWING ANGLE TO TARGET(S)					
VIEWING ANGLE TO SIGNIFICANT PARTS OF WORKSTATION (OTHER THAN DISPLAYS)					
VISUAL DISTORTION FROM WORKSTATION					
VISUAL OBSCURATION FROM WORKSTATION					
VISUAL OBSCURATION WITHIN WORKSTATION					
REFLECTIVITY WITHIN WORKSTATION					
VISIBILITY OF WORKSTATION EXTERIOR					
OTHER:					
		RATING SUM		PRDCT SUM	INDEX

HFE MEASURE #12 - WORKSTATION ENVIRONMENT
SOUND CHARACTERISTICS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

SOUND CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
SOUND FREQUENCY WITHIN WORKSTATION					
SOUND AMPLITUDE WITHIN WORKSTATION					
SOUND FREQUENCY OUTSIDE WORKSTATION					
SOUND AMPLITUDE OUTSIDE WORKSTATION					
OTHER:					
					INDEX:
		RATING SUM		PRDCT SUM	

(9) Count the number of controls and pieces of equipment to be manipulated for the task. Record this number in the # Controls/Equipment box.

(10) Divide the sum by the number of controls/equipment, and multiply the resulting quotient by 100. Record this product in the Index box. This is the Index of Adequacy of Accessibility. If all controls and other equipment to be manipulated are fully accessible, this Index will be approximately 100. The less adequate their accessibility, the further below 100 will be the Index.

HFE MEASURE #13 - WORKSTATION MOTION CHARACTERISTICS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

MOTION CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	
VIBRATION AMPLITUDE IN WORKSTATION					
VIBRATION FREQUENCY IN WORKSTATION					
AMOUNT OF ACCELERATION IN WORKSTATION					
DIRECTION OF ACCELERATION IN WORKSTATION					
CHARACTER OF MOTION IN WORKSTATION					
OTHER:					
					INDEX:
		RATING SUM		PRDCT SUM	

HFE MEASURE #14 - WORKSTATION/ENVIRONMENT
VENTILATION CHARACTERISTICS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

VENTILATION CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
AIR FLOW/TIME					
WORKSTATION TEMPERATURE					
WORKSTATION HUMIDITY					
EXTERNAL WORKSTATION TEMPERATURE					
PREVENTION OF ENTRANCE OF TOXIC SUBSTANCE/RADIATION					
PREVENTION OF ENTRANCE OF NOXIOUS SUBSTANCES					
OTHER:					
RATING SUM:					INDEX:
				PRDCT SUM	

HFE MEASURE #15 - WORKSTATION
HAZARD CHARACTERISTICS WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

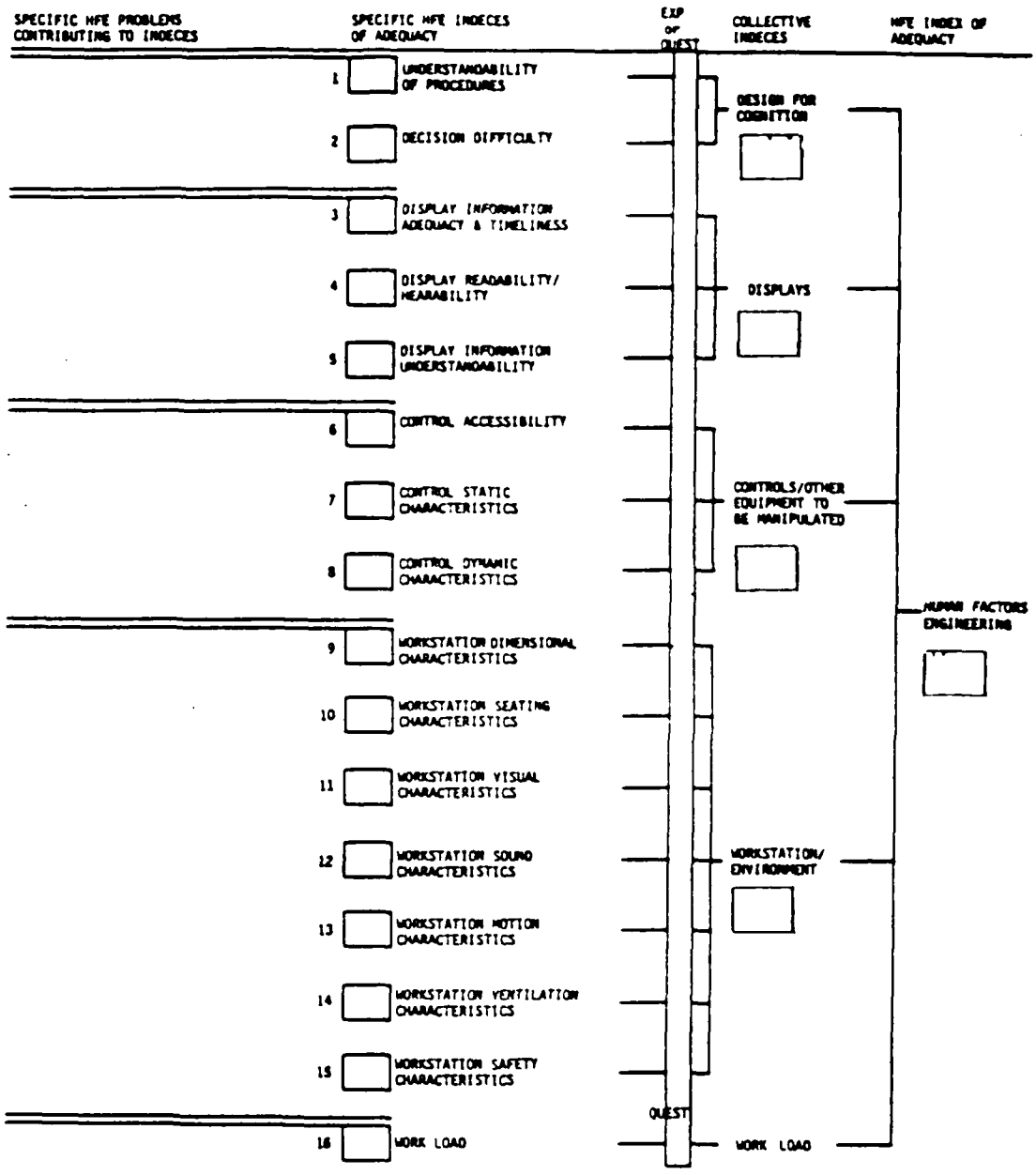
CHARACTERISTICS	RELEVANCE	RATING	D/I	PROCT	SPECIFY	SOURCE
SHARP EDGED OBJECT						
POINTED OBJECT						
SNAGGING OBJECT						
SMALL DIAMETER PROJECTION						
DANGEROUSLY INADEQUATE HEAD CLEARANCE						
EXPOSED EXCESSIVELY HOT MATERIAL						
EXPOSED EXCESSIVELY COLD MATERIAL						
EXPOSED SOURCE OF ELECTRIC SHOCK						
EXPOSED MACHINERY IN MOTION NOT ADEQUATELY HIGHLIGHTED						
TOXIC MATERIAL/RADIATION CONTACTABLE						
NOXIOUS MATERIAL CONTACTABLE						
SOUND PRESSURE AT DANGEROUS LEVEL						
VIBRATION AT DANGEROUS AMPLITUDE/ FREQUENCY						
DANGEROUSLY INADEQUATE ILLUMINATION OF POTENTIAL ACCIDENT SITE						
DANGEROUSLY EXCESSIVE ILLUMINATION						
INADEQUATE EQUIPMENT ANCHORING						
INADEQUATE PERSONNEL RESTRAINT						
INADEQUATE EQUIPMENT PADDING						
SLIPPERY WALKING SURFACE						
SLIPPERY CLIMBING SURFACE						
CLIMBING SURFACE WITHOUT ADEQUATE FOOTHOLDS						
LIFTING/CLIMBING SURFACE WITHOUT ADEQUATE HANDHOLDS						
INADEQUATE GUARDRAILS/SHIELDING						
DANGEROUS HARDWARE/SOFTWARE CONDITION NOT ADEQUATELY SIGNALED						
DANGEROUS ENVIRONMENTAL CONDITION NOT ADEQUATELY SIGNALED						
DANGEROUS TACTICAL CONDITION NOT ADEQUATELY SIGNALED						
OTHER:						
	RATING SUM		PROCT SUM		INDEX	

SUMMARY WORKSHEET FOR
HUMAN FACTORS ENGINEERING DIAGNOSIS

TASK: _____

CONDITIONS (if applicable): _____

ISSUE: _____



SYSTEM _____ TEST _____ DATE _____ PAGE _____

NAME _____ TELEPHONE _____

PERSONNEL SELECTION MEASURES

CONTENTS:

CONTENTS (CONTINUED)

GENERAL INSTRUCTIONS FOR PERSONNEL SELECTION MEASURES

DESCRIPTION: An operational test (OT) has been completed recently. For the specifics of this OT, see the "Task Evaluation Worksheet" of this submission. Various operator and maintainer tasks were measured during this OT. One or more of these tasks was evaluated as having been performed inadequately.

Operational testing and evaluation personnel have determined that those tasks that are listed are of significant importance to the overall evaluation of the system that was tested. They need to know <u>why</u> these tasks were performed inadequately. One possible reason is that the individual or individuals who performed inadequately had significant characteristics that interacted with the system hardware/software and that fell outside the fifth to ninety-fifth percentile envelopes for the appropriate population. In the case of measures of central nervous system functioning, one possible reason is that the individual or individuals fell below the fifth percentile for the characteristics in question.

It is not necessary to take any personnel selection measures if you can be <u>sure</u> that all the personnel who performed inadequate were "representative soldiers" in all their significant characteristics. Being a representative soldier implies that these individuals fell within the fifth to ninety-fifth percentiles for those significant characteristics which would affect task performance. Since system hardware and software were supposed to be designed for "representative soldiers" if the soldiers were representative, this could not be the cause of inadequate performance. However, the random selection of military units to act as players in an OT does not guarantee the representativeness of the soldiers involved.

Further, you must deal with the question of whether a "representative soldier" is supposed to represent the specific military population, or the appropriate age group of the general population.

This section includes a set of "Common Procedures" that applies to all of the listed Personnel Selection Measures. If you have also received the HRTES HFE Measures, you will notice that the Personnel Selection Measures "Common Procedures" are largely identical to the HFE Measures "General Procedures" plus their "Common Procedures."

Your first problem will be to decide which Personnel Selection Measures to take of each task to be diagnosed. During the OT, players and observers filled in questionnaires in which they gave their opinions of the difficulty of each task and the reasons for significant difficulty.

If any player or observer thought that performing a given task was difficult and that task is one of those being analyzed now, you will have a questionnaire for it. In this case the scale scores listed may be helpful to you in deciding which Personnel Selection Measures to take. If a score indicates significant difficulty (50 or below), it is reasonable to take the corresponding Personnel Selection Measure(s) for that task. In some cases several Personnel Selection Measures, taken together, correspond to one questionnaire. It is, of course, possible that players and observers were not able to judge whether there was something which was inadequate and produced inadequate task performance. Therefore these scores, if they are available, can only be a guide for you to use as you think best.

Since the scales of the "Opinion Summary Data Worksheet" and the Personnel Selection Measures do not always equal each other on a one scale to one measure relationship, the following table is presented.

RATING SCALES	NUMBERS OF PERSONNEL SELECTION MEASURES
1. Understanding Procedures	1+2
2. Display Readability/Hearability Measurement	3+4 and/or 5+6
3. Display Information Understanding	1+2
4. Usefulness of Display Information	None
5. Manipulation Difficulty	12+13+14
6. Reach/Accessibility	7+8+9
7. Control Configuration	10+11
8. Decision Difficulty	1+2
9. Target/Terrain Visibility	17
10. Workstation Design for Visibility	17
11. Noise	18
12. Motion	19
13. Ventilation	20
14. Temperature	20
15. Workstation Dimensions	15
16. Seating	15
17. Workload	21
18. Safety	None
19. Training Time	See Training Measures
20. Training Method	See Training Measures
21. Practice Condition	21
22. Trainer(s)	See Training Measures

You can use these scale scores as an aid in deciding which Personnel Selection Measures to take. However, you cannot use them in place of Personnel Selection Measures. The reason for this is as follows:

(1) Scale scores are parallel to both Personnel Selection and HFE Measures.

(2) If a given scale score were used to replace both its parallel Personnel Selection and HFE Measures, one would not be able to differentiate between Personnel Selection and HFE causes of inadequate performance.

(3) One could use a given scale score to replace one of a parallel measure pair--if the other parallel measure indicated no difficulty, or if the other parallel measure were considered fixed and therefore not taken.

(4) It is considerably more likely that Personnel Selection will be considered fixed than will HFE. Further, personnel characteristics are more likely to require specific documentation as causes of inadequate performance than are HFE.

(5) Therefore, scale scores can only be used as replacements for HFE Measures, not Personnel Selection Measures, and even this replacement is discouraged in HRTES.

COMMON PROCEDURES (APPLICABLE TO ALL PERSONNEL SELECTION MEASURES):

(1) Examine the questionnaires for each task. Use their scores as an aid to selecting parallel Personnel Selection Measures. If you do not have one or more such Worksheets, use your best judgement for deciding which measures to take of each task.

(2) Make sufficient copies of the Personnel Selection Measure Worksheets so that you have as many as you need for each HPF to be diagnosed.

(3) Study the characteristics listed on each worksheet. If you think that a significant characteristic is missing, add it in the "Other" category.

(4) Decide if each characteristic on the Worksheet is relevant to the performance of the task being diagnosed in this system. If it might have a significant effect on task performance in this system, it is relevant. In this case record an "X" in the appropriate cell of the Relevance Column. If a characteristic is not relevant, record a "0" in the cell.

(5) If there is a column for designating specific part of body, complete it for each selected characteristic.

(6) Rate each characteristics <u>that you have selected</u> on the criticality scale which follows. Select any rating from 1-100. Record the rating in the appropriate cells of the Rating Column.

LOW CRITICALITY		MODERATE CRITICALITY		HIGH CRITICALITY
1	25	50	75	100
Just important enough to be measured. Criticality low for this task		Criticality moderate for this task		Criticality extremely high for this task.

(7) Obtain appropriate measurements of each characteristic you have selected. This may be done in the following ways:

(a) Obtaining appropriate measurements from previous OT's, DT's, HFE tests, or other reasonably reliable sources.

(b) Physically taking the necessary measurements from the actual system.

(c) Taking some version of the necessary measurements from system documentation.

(8) Compare each measurement with the standard or specification which applies to it. This may be done in the following ways:

(a) Comparison with reasonably valid specifications such as those found in MIL STD-1472, HEDGE, and HFTEMAN--that is, of course, preferable.

(b) Evaluation based on expert judgment--in the absence of an applicable standard your judgment may be substituted.

(9) Remember, this procedure applies only to those individuals who performed the given task below criterion. If a given characteristic, for one individual, falls inside the fifth to ninety-fifth percentile envelope, or exceeds the appropriate standard, or your judgment, assign (do not record) a 1. If it does not, assign a 0. If only one dividual performed this task inadequately, then the 1 or 0 assigned that individual's

characteristic is recorded directly in the appropriate cell of the (0/1) column. However, if more than one individual performed this task inadequately, you will have to compute the mean of the zeros and ones for this characteristic. Once this has been computed, record the mean of the zeros and ones assigned to the given characteristic in the appropriate cell of the (0/1) column.

(10) Record the source of each comparison in the appropriate cell of the Source Column. This should be information as to the source of the measurement itself and the standard. If there is insufficient space to record all the required source information, append a page and use the space to refer to it.

(11) Multiply the 0, 1, or mean for each characteristic by the 1-100 rating of its criticality. Record the resulting products in the appropriate cells of the Product Column.

(12) Add all the products, and record the resulting sum in the Product Sum Cell.

(13) Add all the 0 or 1 ratings in the Rating Column, and record the resulting sum in the Rating Sum Cell.

(14) Divide the Product Sum by the Rating Sum, and muliply the resulting quotient by 100. Record the resulting product in the Index Cell. This is the Index of Adequacy for this measure. If the measures of the significant characteristics just met their standards, the Index would be approximately 100. The less adequate the characteristics that are measured, considering their criticality, the farther below 100 will be the Index.

(15) When you have finished taking the measures you have selected for each task, make as many copies of the "Summary Worksheet for Personnel Selection Analysis" as you need for the tasks you have diagnosed.

(16) Record the specific Personnel Selection indices of adequacy for the measures you have taken for each task being diagnosed. This is to be done in the appropriately labeled boxes on the Worksheets.

(17) If you have not taken a specific Personnel Selection Measure for a given task, record an "X" in the appropriate box of the Worksheet.

(18) Record the specific characteristic(s) which caused any specific Index of Adequacy to be significantly below 100. This is to be done in the first column of the Worksheet. If necessary, append an additional sheet for this purpose, and reference it in the first column.

(19) Compute the means of the specific Indices of Adequacy according to the branching structure on the Worksheet. Means are to be computed of Indices: 1+2; 3+4; 5+6; 7+8+9; 10+11; 12+13+14; 15-21. Record the resulting seven means in those boxes to which the branching structure leads. Next, comptue the means of the following means from the previous step: (3+4)+5+6) and (7+8+9)+ 10+11)+(12+13+14). Finally, take these two newly computed means, and compute the means of the following: (1+2; (3+4+5+6); (7-14); (15-21); and (22). Record the resulting means in those boxes on the Worksheet appropriate for them.

(20) If all the specific indices are absent, for a given collective index, record an "X" in the box for that collective index. If you have recorded an "X" in any individual box, leave it out of the computation.

(21) When you have completed all the Personnel Selection Measures and the "Summary Worksheet for Personnel Selection Analysis" return all materials to sender.

PERSONNEL SELECTION MEASURE #1-- BACKGROUND THAT BEARS ON COGNITIVE FUNCTIONING ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
CIVILIAN EDUCATION LEVEL					
AMOUNT OF APPROPRIATE CIVILIAN EXPERIENCE					
LENGTH OF MILITARY SERVICE					
MILITARY RANK					
MOS					
MOS SKILL LEVEL					
AMOUNT OF APPROPRIATE MILITARY EXPERIENCE					
SPECIFIC MILITARY TRAINING IN SYSTEM TYPE					
QUALIFICATION LEVEL WITH SYSTEM					
TIME SINCE QUALIFICATION WITH SYSTEM					
OTHER:					
RATING SUM:			PRDCT SUM		INDEX:

PERSONNEL SELECTION MEASURE #2
APTITUDE/ABILITY THAT BEARS ON
COGNITIVE FUNCTIONING ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
READING APTITUDE/ABILITY					
VOCABULARY ABILITY					
MATHEMATICS/NUMERICAL APTITUDE ABILITY					
SPATIAL ORIENTATION APTITUDE/ABILITY					
MEMORIZATION APTITUDE/ABILITY					
REASONING APTITUDE/ABILITY					
OTHER:					
RATING SUM:				PRDCT SUM	INDEX:

PERSONNEL SELECTION MEASURE #3
VISION DISPLAY USE ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	Relevance	EYE: RT, LT, OR B.	RATING	O/I	PROCT	SOURCE
VISUAL ACUITY-NEAR (AT DISPLAY DISTANCE)						
VISUAL DISCRIMINATION (RETINAL PERIPHERY)						
COLOR DISCRIMINATION						
DEPTH DISCRIMINATION						
MOVEMENT DISCRIMINATION						
VISUAL SEARCH						
DARK ADAPTATION						
LIGHT ADAPTATION						
EYE DOMINANCE		X				
FATIGUE TOLERANCE FOLLOWING-LONG TERM USE OF DISPLAY(S)		X				
OTHER:						
RATING SUM				PROC SUM=		INDEX

PERSONNEL SELECTION MEASURE #8
JOINT MOTION FOR ACCESSIBILITY ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT. LT. OR B.	RATING	0/1	PRDCT	SOURCE
WRIST FLEXION						
WRIST EXTENSION						
WRIST ADDUCTION						
WRIST ABDUCTION						
FOREARM SUBINATION						
FOREARM PRONATION						
ELBOW FLEXION						
SHOULDER FLEXION						
SHOULDER EXTENSION						
SHOULDER ADDUCTION						
SHOULDER ABDUCTION						
SHOULDER MEDIAL ROTATION						
SHOULDER LATERAL ROTATION						
ANGULAR LIMITS OF WHOLE ARM HORIZONTAL MOTION (SPEC. HAND HEIGHT ABOVE SEAT)						
ANKLE FLEXION						
ANKLE EXTENSION						
ANKLE ADDUCTION						
ANKLE ABDUCTION						
KNEE FLEXION						
KNEE MEDIAL ROTATION						
Continued on Following Page						
		RATING SUM		PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #8--CONT'D.

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT, LT. OR B.	RATING	0/1	PRDCT	SOURCE
KNEE LATERAL ROTATION						
HIP FLEXION						
HIP ADDUCTION						
HIP ABDUCTION						
HIP MEDIAL ROTATION						
HIP LATERAL ROTATION						
OTHER:						
RATING SUM			PRDCT SUM=			INDEX

PERSONNEL SELECTION MEASURE #9
SIZE ANTHROPOMETRY FOR ACCESSIBILITY ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT, LT, OR B.	RATING	0/1	PRDCT	SOURCE
SHOULDER (BIDELTOID) BREADTH		X				
CHEST DEPTH		X				
WAIST DEPTH		X				
BUTTOCK-ABDOMEN DEPTH		X				
HIP BREADTH (STANDING)		X				
HIP BREADTH (SQUATTING)		X				
HAND BREADTH						
HAND THICKNESS						
HAND LENGTH						
FOREARM DIAMETER/CIRCUMFERENCE						
BICEP DIAMETER/CIRCUMFERENCE						
THIGH CLEARANCE						
THIGH CIRCUMFERENCE						
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #10
VISION FOR MANIPULATION ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	EYE: RT, LT, OR B.	RATING	O/1	PRDCT	SOURCE
VISUAL ACUITY-NEAR (AT CONTROL DISTANCE)						
VISUAL DISCRIMINATION (RETINAL PERIPH.)						
COLOR DISCRIMINATION						
DARK ADAPTATION						
LIGHT ADAPTATION						
EYE DOMINANCE		X				
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #11
ANTHROPOMETRY FOR STATIC CHARACTERISTICS OF CONTROLS/EQUIPMENT TO BE MANIPULATED ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT., LT. OR B.	RATING	0/1	PRDCT	SOURCE
FOOT TO EYE HEIGHT (STANDING)		X				
BUTTOCK TO EYE HEIGHT (SITTING)		X				
HANDEDNESS		X				
HAND BREADTH						
INDEX FINGER TIP DIAMETER/CIRCUMFERENCE						
MIDDLE FINGER TIP DIAMETER/ CIRCUMFERENCE						
RING FINGER TIP DIAMETER/CIRCUMFERENCE						
THUMB LENGTH TIP-FIRST JOINT						
THUMB DEPTH						
FOOT BREADTH						
NECK FLEXION-LEFT		X				
NECK FLEXION-RIGHT		X				
NECK FLEXION-DORSAL		X				
NECK FLEXION-VENTRAL		X				
NECK ROTATION-RIGHT		X				
NECK ROTATION-LEFT		X				
ANGLE OF SIGHT AT EXPECTED HEAD POSITION						
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #12
STRENGTH FOR MANIPULATION ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT, LT, OR B.	STRENGTH: S OR EX	CONTROL: V OR H	RATING	O/1	PRDCT	SOURCE
THUMB-INDEX FINGER GRASPING STRENGTH								
EXTENDED INDEX FINGER STRENGTH IN FLEXION								
EXTENDED MIDDLE FINGER STRENGTH IN FLEXION								
GRIP STRENGTH								
ARM STRENGTH PULLING STRAIGHT BACK (SPECIFY ELBOW FLEXION)								
ARM STRENGTH PUSHING STRAIGHT FORWARD (SPECIFY ELBOW FLEXION)								
ARM STRENGTH MOVING TO THE RIGHT (SPECIFY ELBOW FLEXION)								
ARM STRENGTH MOVING TO THE LEFT (SPECIFY ELBOW FLEXION)								
ARM STRENGTH MOVING UP, VERTICALLY (SPECIFY ELBOW FLEXION)								
ARM STRENGTH MOVING DOWN, VERTICALLY (SPECIFY ELBOW FLEXION)								
ARM STRENGTH MOVING CLOCKWISE (SPECIFY ELBOW FLEXION)								
ARM STRENGTH MOVING COUNTERCLOCKWISE (SPECIFY ELBOW FLEXION)								
LEG STRENGTH PUSHING FROM SEATED POSITION (SPECIFIY KNEE ANGLE)								
LEG STRENGTH IN A VERTICAL UPWARD PULL								
BACK STRENGTH IN A VERTICAL UPWARD PULL								
WHOLE BODY STRENGTH IN A VERTICAL UPWARD PULL								
WHOLE BODY STRENGTH IN A HORIZONTAL PUSH (FROM A SQUAT)								
WHOLE BODY STRENGTH IN A HORIZONTAL PUSH (STANDING)								
FATIGUE TOLERANCE FOLLOWING-LONG TERM USE OF REQUIRED STRENGTH								
OTHER:								
					RATING SUM		PRDCT SUM	INDEX

PERSONNEL SELECTION MEASURE #13
RANGE OF MOVEMENT FOR MANIPULATION ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT. OR LT.	RATING	O/I	PRDCT	SOURCE
WRIST FLEXION						
WRIST EXTENSION						
WRIST ADDUCTION						
WRIST ABDUCTION						
FOREARM SUPINATION						
FOREARM PRONATION						
ELBOW FLEXION						
SHOULDER FLEXION						
SHOULDER EXTENSION						
SHOULDER ADDUCTION						
SHOULDER ABDUCTION						
SHOULDER MEDIAL ROTATION						
SHOULDER LATERAL ROTATION						
ANKLE ADDUCTION						
ANKLE ABDUCTION						
ANKLE FLEXION						
KNEE ROTATION						
KNEE FLEXION						
OTHER:						
		RATING SUM		PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #14
COORDINATION FOR MANIPULATION ADEQUACY WORKSHEET

TASK: _____

CLEARANCE: _____

CHARACTERISTICS	RELEVANCE	LIMB: RT, LT, OR B.	RATING	O/I	PRDCT	SOURCE
GROSS BODY COORDINATION		X				
MULTI-LIMB COORDINATION		X				
HAND-EYE COORDINATION						
MANUAL DEXTERITY						
FINGER DEXTERITY						
PEDAL DEXTERITY						
CONTROL PRECISION						
RATE CONTROL						
FATIGUE TOLERANCE FOLLOWING-LONG TERM PERFORMANCE OF APPROPRIATE MOVEMENTS						
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #15
ANTHROPOMETRY FOR WORKSTATION/ENVIRONMENT DIMENSIONS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
STATURE					
SHOULDER HEIGHT (STANDING)					
SHOULDER BREADTH					
CHEST DEPTH					
CHEST BREADTH					
WAIST DEPTH					
ELBOW HEIGHT (STANDING)					
HIP BREADTH (STANDING)					
BUTTOCK-ABDOMEN BREADTH (STANDING)					
KNEE BREADTH SPECIFY LEFT RIGHT OR BOTH					
HEAD CIRCUMFERENCE					
FOOT LENGTH SPECIFY LEFT OR RIGHT					
FOOT BREADTH SPECIFY LEFT RIGHT OR BOTH					
PRONE LENGTH					
PRONE HEIGHT					
CRAWLING LENGTH					
CRAWLING HEIGHT					
KNEELING LENGTH					
KNEELING HEIGHT (CROUCHING)					
KNEELING HEIGHT (UPRIGHT)					
CONTINUED ON FOLLOWING PAGE					
		RATING SUM:		PRDCT SUM	INDEX:

PERSONNEL SELECTION MEASURE #15--CONT'D.

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	O/I	PRDCT	SOURCE
MINIMUM SQUATTING HEIGHT					
SQUATTING HEIGHT (UPRIGHT)					
VERTICAL TRUNK CIRCUMFERENCE (STANDING)					
BUTTOCK-EYE HEIGHT (SITTING)					
BUTTOCK-EYE HEIGHT (STANDING)					
NECK FLEXION-LEFT					
NECK FLEXION-RIGHT					
NECK FLEXION-DORSAL					
NECK FLEXION-VENTRAL					
NECK ROTATION-RIGHT					
NECK ROTATION-LEFT					
ANGLE OF SIGHT AT EXPECTED HEAD POSITION					
OTHER:					
RATING SUM:				PRDCT SUM	INDEX:

PERSONNEL SELECTION MEASURE #16
ANTHROPOMETRY FOR SEATS ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT, LT, OR B.	RATING	0/1	PRDCT	SOURCE
SITTING HEIGHT (ERECT)		X				
SITTING HEIGHT (RELAXED)		X				
SHOULDER HEIGHT (SITTING)						
ELBOW REST HEIGHT (SITTING)						
ELBOW-FINGERTIP LENGTH						
HEAD LENGTH		X				
BUTTOCK-KNEE LENGTH						
POPLITEAL HEIGHT						
BUTTOCK-POPLITEAL LENGTH						
BUTTOCK-HEEL LENGTH						
FOOT LENGTH						
BUTTOCK-HEEL LENGTH (DIAGONAL)						
HEAD BREADTH		X				
SHOULDER (BIDELTOID) BREADTH		X				
FOREARM-FOREARM BREADTH		X				
WAIST BREADTH (SITTING)		X				
HIP-HIP BREADTH (SITTING)		X				
THIGH CLEARANCE HEIGHT (SITTING)		X				
THIGH BREADTH (SITTING)						
KNEE-KNEE BREADTH (SITTING)		X				
Continued on Following Page						
		RATING SUM		PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #16--CONT'D.

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	LIMB: RT, LT, OR B.	RATING	0/1	PRDCT	SOURCE
FOOT-FOOT BREADTH						
WEIGHT						
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #17
VISION FOR WORKSTATION/ENVIRONNMENT ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	EYE: RT, LT, OR B.	RELEVANCE	RATING	0/1	PRDCT	SOURCE
VISUAL ACUITY-NEAR (AT DISTANCE FROM SIGNIFICANT PART OF WORKSTATION)						
VISUAL ACUITY-INTERMEDIATE (AT DISTANCE FROM ENVIRONMENT FEATURE)						
VISUAL ACUITY-FAR (AT DISTANCE FROM TARGET)						
VISUAL DISCRIMINATION (RETINAL PERIPH)						
COLOR DISCRIMINATION						
DARK ADAPTATION						
LIGHT ADAPTATION						
DEPTH DISCRIMINATION						
MOVEMENT DISCRIMINATION						
VISUAL SEARCH						
EYE DOMINANCE						
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #18
AUDITION FOR WORKSTATION/ENVIRONMENT ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	RELEVANCE	EAR: RT, LT, OR B.	RATING	0/1	PRDCT	SOURCE
AUDITORY ACUITY AT NATURAL SPEECH FREQUENCY RANGE						
ABILITY TO DISCRIMINATE NATURAL SPEECH FREQ. RANGE FROM APPROPRIATE MASKING						
HEARING RECOVERY FOLLOWING-IMPULSE NOISE APPROPRIATE TO SYSTEM FUNCTIONS						
HEARING RECOVERY FOLLOWING-BLAST APPROPRIATE TO SYSTEM FUNCTIONS						
HEARING RECOVERY FOLLOWING-LONG TERM, HIGH LEVEL STEADY-STATE NOISE						
FATIGUE TOLERANCE FOLLOWING-IMPULSE NOISE APPROPRIATE TO SYSTEM FUNCTIONS		X				
FATIGUE TOLERANCE FOLLOWING-BLAST APPROPRIATE TO SYSTEM FUNCTIONS		X				
FATIGUE TOLERANCE FOLLOWING-LONG TERM, HIGH LEVEL, STEADY-STATE NOISE		X				
FATIGUE TOLERANCE FOLLOWING-LONG TERM, LOW LEVEL, STEADY-STATE NOISE		X				
OTHER:						
RATING SUM				PRDCT SUM		INDEX

PERSONNEL SELECTION MEASURE #19
CENTRAL NERVOUS SYSTEM FUNCTIONING FOR COMPATIBILITY WITH WORKSTATION MOTION ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (if applicable): _____

CHARACTERISTICS	VECTOR	RELEVANCE	RATING	O/1	PRDCT	SOURCE
MOTION SICKNESS/VERTIGO TOLERANCE TO VIBRATION OF APPROP. Hz AND AMPLITUDE						
VOLUNTARY MUSCULAR CONTROL TOLERANCE TO VIBRATION OF APPROP. Hz AND AMPLITUDE						
REACTION TIME TOLERANCE TO VIBRATION OF APPROP. Hz AND AMPLITUDE						
PERCEPTUAL TOLERANCE TO VIBRATION OF APPROP. Hz AND AMPLITUDE						
COGNITIVE TOLERANCE TO VIBRATION OF APPROP. Hz AND AMPLITUDE						
FATIGUE TOLERANCE FOLLOWING LONG TERM VIBRATION OF APPROP. Hz AND AMPLITUDE						
MOTION SICKNESS/VERTIGO TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
VOLUNTARY MUSCULAR CONTROL TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
REACTION TIME TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
PERCEPTUAL TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
COGNITIVE TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
POSTURAL TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
COMMUNICATION TOLERANCE TO ACCELERATION OF APPROP. ONSET/DURATION						
FATIGUE TOLERANCE FOLLOWING SUSTAINED ACCELERATION OF APPROP. ONSET						
OTHER:						
RATING SUM				PRDCT SUM=		INDEX

PERSONNEL SELECTION MEASURE #20

CHARACTERISTICS REQUIRED FOR WORKSTATION VENTILATION AND AIR FILTRATION ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	O/1	PRDCT	SOURCE
HIGH TEMPERATURE+HIGH HUMIDITY TOLERANCE IN APPROP. CLOTHING/GEAR OVER APPROP. TIME					
HIGH TEMPERATURE+LOW HUMIDITY TOLERANCE IN APPROP. CLOTHING GEAR OVER APPROP. TIME					
LOW TEMPERATURE TOLERANCE IN APPROP. CLOTHING GEAR OVER APPROP. TIME					
ENGINE COMBUSTION PRODUCTS TOLERANCE OVER APPROP. TIME					
GUNFIRE PRODUCTS TOLERANCE OVER APPROP. TIME					
ROCKET FIRE PRODUCTS TOLERANCE OVER APPROPRIATE TIME					
TOLERANCE TO REDUCED OXYGEN SUPPLY OVER APPROPRIATE TIME					
TOLERANCE TO CHEMICAL WARFARE PRODUCTS OVER APPROP. TIME					
TOLERANCE TO BIOLOGICAL WARFARE PRODUCTS OVER APPROP. TIME					
TOLERANCE TO NUCLEAR WARFARE PRODUCTS OVER APPROP. TIME					
OTHER:					
RATING SUM:				PRDCT SUM	INDEX:

PERSONNEL SELECTION MEASURE #21
PHYSIOLOGICAL INDICES OF WORKLOAD
TOLERANCE ADEQUACY WORKSHEET

TASK: _____

CONDITIONS (If applicable): _____

CHARACTERISTICS	RELEVANCE	RATING	0/1	PRDCT	SOURCE
LEVEL OF SECONDARY TASK PERFORMANCE					
SIZE OF PUPIL DILATION					
RATE OF RHYTHMIC CONTRACTION AND DILATION OF PUPIL					
EYE MOVEMENT RATE					
RATE OF SINUS ARRHYTHMIA					
LEVEL OF PERIPHERAL VASOCONSTRICTION					
LEVEL/RATE OF ALTERATION IN SKIN CONDUCTANCE					
LEVEL OF EEG DESYNCHRONIZATION					
OTHER:					
RATING SUM:			PRDCT SUM		INDEX:

SUMMARY WORKSHEET FOR PERSONNEL SELECTION ANALYSIS

TASK: _____

CONDITIONS (if applicable): _____

ISSUE: _____